Between buildings and streets

A study of the micromorphology of the London terrace and the Manhattan row house 1880-2013

by

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I, Garyfalia Palaiologou confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Signed,

January 2015

Abstract

This thesis examines the role of building morphology and street networks in shaping street activity and transformations in the historical built form. The core inquiry applies a configurational analysis to the street, viewing it as a complex entity which interfaces with both buildings and the urban street network. The research is founded on the identification of two theoretical and methodological gaps in the canon of urban design: how generic building morphology properties relate to street liveability; and, how urban diversity emerges as the result of diachronic processes. The thesis looks at architecture beyond function, geometry and aesthetics, focusing on the urban street as a generator for social contact. Building on space syntax theory, it seeks to advance the concept of the 'virtual community', proposing that *encounter and co-presence patterns are the product of both city-wide connections and local building morphology.*

In order to study building-street relations in terms of the virtual community the thesis has developed a series of specialised techniques to describe and analyse the synchronic and diachronic aspects of space. The thesis is innovative in integrating space syntax and Conzenian methods to better examine the *micromorphology* of the street interface configurationally and typologically, capturing the changing nature of built form and building use over time. This methodology is applied to the study of two contrasting urban areas: Islington, London and West Village, Manhattan. Both possess similar building morphologies that have sustained street liveability and diversity over centuries.

The results show how urban change and diversity are affected by diachronic processes working with the synchronic structure of the everyday city. The thesis asserts that urban configuration and built form together play an essential role in shaping the character of the 'virtual community' as well as the potential for street life itself.

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To my parents,

and my supervisor.

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Chapter one - The lost art of building

This first chapter explains the reasoning behind the research presented in this thesis. Section 1.1 summarises the dissertation's inquiry and its key ideas. Section 1.2 introduces the shortcomings in contemporary urban design theory and practice which have prompted this research. Sections 1.3 and 1.4 discuss the research questions posed and approaches adopted in structuring the main theoretical and methodological contributions of the thesis. The final two sections conclude the introduction, presenting the objectives and outline of the following chapters.

1.1. Between buildings and streets

This thesis is concerned with the interface of buildings, streets and the city; or in other words, with the architectural and urban scales and how they overlap to form urban spatio-temporal phenomena. The object is to demonstrate that there is a theoretical and methodological failing in current urban design literature. Urban design theory and research fails to conceptualise and represent, in an integrated framework, these fundamental city elements: buildings and streets, while considering them in relation to people using urban space – what Bill Hillier calls the 'spatial culture' of cities (1989). The thesis reflects upon and advances two key concepts introduced by space syntax theory in the 1980s: the notion of the 'virtual community' and of 'probabilistic spaces'. It asserts that these early space syntax ideas contain significant potentials which remain underexplored. Despite the fact these concepts contribute fundamentally to our understanding of the way cities and built form organise everyday life, they lack a micro-morphological view – linking the building to the city – that is also configurational. This thesis provides a *configurational study of the micromorphology* of urban streets, and more particularly of the *building-street interface*. In order to supply this missing link that limits the value of the virtual community concept, the thesis develops novel techniques and measures to analyse the syntactical properties of street-facing building morphologies that have emerged as the result of diachronic processes. The proposed methodological integration of syntactical (space syntax) and historico-morphological (Conzenian) approaches is tested via a historical, in-depth study of the streets and vernacular buildings found in two cities: London and New York.

The next sections discuss further the theoretical and methodological origins of this thesis. Four core space syntax publications have had a significant influence in the development of the key arguments behind this thesis: 'Space, culture and urban design in late modernism and after' (1989) by John Peponis, where the author raises fundamental questions regarding urban design issues; 'Creating life: Or, does architecture determine anything' (Hillier et al., 1987) where the concept of the 'virtual community' is introduced and developed later in 'The architecture of the urban object' (1989) by Bill Hillier; and finally, 'The architecture of community' (1989) by Julienne Hanson and Bill Hillier – a publication that brings to the fore the importance of built forms which work 'probabilistically' in terms of the spatio-temoral phenomena they generate. The following account aims to expose the underexplored potential of these key space syntax ideas, and to propose the concepts and methods by which they may be advanced. The thesis also delivers research which establishes this is the case.

1.2. The problem of architecture as a social resource

The nature of the relationship between architecture and society has been extensively debated from a variety of theoretical perspectives (c.f. Lévi-Strauss, 1963; Hillier and Leaman, 1973; Hillier, 1986; Peponis, 1989; Derrida, 1986, 1993; Vidler, 1992). The breadth and diversity in the disciplines from which these voices arose is evident in the intensive discourses which engaged with the modernist thinking on the architecture of cities. In a sense, modernism formally advocated the power of urban design in organising urban life. In his article 'Space, culture and urban design in late modernism and after' (1989), Peponis gives a critical and comprehensive review of issues raised in relation to urban design since the 1960. The author reflects that the modernist movement inspired debates as to whether this power of architecture over society does indeed exist, and then around the potential ways in which society *could* be organised through space and design, and what the desired socio-cultural outcomes would be. Put simply, the urban design critiques which followed modernism addressed the issues of what kind of cities we want to live in, and how best to design those cities.

A fundamental consequence of this discourse on urban design is the highlighting of the importance of populated streets – namely, streets which are active, in the sense that there is human activity taking place in them (c.f. Whyte, 1957, 1980; Jacobs, 1961; Gehl, 1971; Appleyard, 1981; Anderson, 1986; Vidler, 2011). Peponis (1989, p.93) argues that the social essence of a city is this random meeting and mixing of familiar and unfamiliar people of different social status, ethnicity and race. On the other hand, for Jacobs (1961) and Alexander (1965), street activity is related to functional mixing and overlap, and high densities. Essentially, Jacobs and Alexander refer to buildings and their functions and the way these buildings/functions are organised in space. The key point, however, is that all these reflections on the nature of cities emerged as an attempt to inform urban design and instruct urban designers in how to achieve the sustenance of vibrant and diverse public life and street activity – features which in fact appear to be inherent in ordinary, unplanned building cultures. This need to plan and design working, nourishing complexities similar to those supported by the informal collective architecture of historical urban settlements remains largely an unsolved problem in urban design – and one that is addressed in this thesis.

Peponis draws a very important insight into the reason why *ordinary* building remains an *extraordinary* puzzle for architecture: before designing the city comes the need to understand it: not only in terms of the visible outcomes of its socio-spatial phenomena, but also the processes that generate those outcomes. The author believes that in order for reflections on urban phenomena to have practical value for design purposes there is a necessity to interpret observations regarding social and cultural meaning into insights regarding physical properties of the architectural morphology (p.94-95). This is the aim of the thesis here; to explore the potential impact of building morphology on the spatio-temporal phenomena taking place in the urban street domain.

For instance, the idea of familiar-unfamiliar people in streets was discussed before Peponis by Hillier and Hanson in the spatial context of the ‘inhabitants-strangers’ conceptual model (1984, p.17). Hillier and Hanson assigned a spatial dimension to social relations. Accordingly, the ‘familiar’ refers to people using the ‘local’ environment, while the ‘unfamiliar’ refers to the whole city and its users – the ‘global’. While Jacobs and Alexander’s observations on density, mixing and overlap of uses offer insights into the visible properties of urban space, their insights into the *physical properties* of urban space in terms of morphology (and not only function) are not specific enough to provide guidance for urban design. Many years later, Marshall (2012) identifies that this remains the case and urban design research still has not advanced those arguments very far. The fact that the properties observed by Jacobs and Alexander have not been studied and understood at a morphological level reveals a gap in methodology and research that this thesis addresses.

Since its conception in 1970s (Hillier et al., 1976), space syntax methodology has been developing the analytical tools to examine society ‘through the prism of space’ (Hillier and Netto, 2002). These methods describe relational aspects of the spatial layout and provide a *configurational* understanding of spatial systems which extends beyond that which we can perceive when simply looking at the form of space – for example, when evaluating cities solely in terms of empirical observations or in terms of their geometrical properties. By contrast, the syntactical approach allowed for an understanding of the way large-scale spatial systems such as cities work as coherent structures, as network entities. To date the urban-scale research focus has been essentially concerned with the street network as the fundamental medium of urban life. Yet if we consider the argument by Peponis mentioned earlier, regarding the contribution of urban design literature to design knowledge, it is apparent that this large-scale focus can only meaningfully inform architecture at the urban scale – as opposed to the design scale, which is the primary concern of the research presented in this thesis.

The architecture of the city, however, is as much about streets as it is about buildings. Urban designers and architects need to have insights not only regarding how to understand and acknowledge the effects of urban grids on shaping spatio-temporal phenomena, but also regarding the design of buildings as a *social* resource to public life – beyond function, aesthetics and cultural symbolism. Even Peponis supports in his argument the preoccupation with the effects of the ‘global’ instead of the ‘local’ (p.93) and leads away the focus from what he has been arguing as crucial – a syntactical understanding of architecture (streets and buildings). The thesis suggests that the issue of scales in urban space needs to acknowledge that both micro- and macro- processes have an effect on urban systems which is not exclusive, but complementary.

This thesis revisits key, formative, ideas in the space syntax theory that need further development in order to re-examine the that the difficulty in recognising architecture as a social resource is primarily a configurational problem – in the light of the evidence presented. This thesis advances the argument further by maintaining that configuration is a fundamental property of space not only for street patterns but for building patterns as well and that the virtual community that sustains social life has both a micro-morphology as well as a macro-morphology.

1.3. Describing abstract complexities

1.3.1. 'Micro' and 'macro' scales

Discussing *The Constitution of Society*, Giddens (1986, p.139-144) reflects on the distinction of the 'micro' and 'macro' scales in sociological context (i.e., micro- and macrosociology). His ideas are of interest as they bring to the fore reasons why the 'schism' between the micro and macro approaches is questionable. Giddens explains that both scales have structure and intersections, and are affected by the implications of time; and he goes on to clarify that the macro-scale is not simply the agglomeration of many 'microsituations'. Instead, Giddens does not believe that *'there can be any question of either having priority over the other'* (*ibid.*, p.139) and suggests that the two should be considered in an integrated way.

The consideration of both buildings and streets as formative agents of the urban streetscape implies the acknowledgement that the micro-scale is of just as much importance as the macro-scale when studying urban places. On the one hand, a study of the city's micro-scale implies focusing on the properties of the smallest, elementary city component: this is the building, the 'elementary cell' (Hillier and Hanson, 1984). Respectively, a study of urban morphology at the micro-scale refers to the examination of building morphology properties at the level of the individual building (or plot); namely, the city's *micromorphology* (c.f. Conzen, 1960; Whitehand et al., 1999; Whitehand, 2001). On the other hand, studying the city's macro-scale entails the treatment of the city as an entity. When analysing the city as a whole, the street system works in two fundamental formative ways on urban structure – not only in the sense of holding the city together, but in an active way of shaping historico-morphological processes (Hanson, 1989; Hillier, 1989) and spatio-temporal phenomena (Hillier et al., 1993; Hillier, 1996).

Historico-morphological processes refer to the way a city grows over time – to *diachronic* processes; while spatio-temporal phenomena refer to the *synchronic* random effects that are generated by the spatial configuration (Griffiths, 2009). Griffiths (2009) suggests that both the diachronic and synchronic descriptions of spatial elements need to be considered when trying to understand urban space. However, this important suggestion by Griffiths applies to all city elements and not only to the study of streets. The many different dimensions of time and *'the mobilization of time-space'* are also mentioned by Giddens as considerations within the micro- and macro-scales of study (Giddens, 1984, p.72-73). Simply put, the context of diachronic studies of cities refers to a historical study of processes; while understanding the context of synchronic descriptions of cities refers to a syntactical study of configurations. The latter is perhaps the most significant contribution of space syntax theory and methodologies.

The next section suggests firstly that the space syntax approach has contributed to understanding street systems but we have not yet extensively explored its potentials as a method by which we may expand our understanding of building patterns as urban configurations. Secondly, we can see that the concept of micromorphology arising from Conzenian thinking in urban studies can be addressed configurationally.

1.3.2. The micromorphology of the virtual community

In the syntactical approach, the notion of spatial *configuration* is central. Spatial configuration addresses the way spaces are linked to form a system by scrutinizing the relational properties of that system. In the early 1990s, the properties of spatial configuration were related by space syntax theory and evidence-based research to the patterns of pedestrian movement. More particularly, Hillier et al. (1993) introduced the theory of 'natural movement'. This theory describes how the configurational properties of the layout of the street network will render some streets more prominent as routes or destinations than others. Natural movement is *'the movement generated* *by the grid configuration'* (*ibid.*, p.32) and as Hillier clarifies later in *Space is The Machine* (1996) natural movement is related to the structure of the 'virtual community' – namely, an elementary social entity which is formed simply by people being physically co-present in the same space (Goffman, 1963; Giddens, 1986).

Hillier gives a clear account of the virtual community concept in two earlier publications. The term was introduced in 'Creating life: Or, does architecture determine anything' (1987) and was further developed in 'The architecture of the urban object' (1989). The concept of the virtual community is based on the idea that the users of the city, prior to being social with one another at the city realm, need to be physically co-present and encounter one another. It is conjectured that the higher the potentials for physical co-presence and encounter, the higher the chance for social interaction. Overall, Hillier advances concepts discussed by Goffman and Giddens on co-presence and encounters, by specifying that the virtual community is the 'potential field of probabilistic co-presence and encounter' (Hillier, 1987, p.248) and that it has a structure which varies according to the spatial configuration.

In Hillier's earlier descriptions, the role of buildings in the formation of the virtual community is mentioned in the form of building entrances contributing to probabilistic encounters. However, after *Space is The Machine*, space syntax research primarily focused either on the urban scale and the study of streets or on building interiors – with the exception of Julienne Hanson (2000). Space syntax studies have addressed both the diachronic processes of urban systems and the synchronic performance of cities in terms of the street network, but not in terms of buildings. Conzenian approaches on the other hand have addressed the diachronic processes of building morphology in the context of morphogenesis but neither in a configurational manner nor in a manner that is related to the probabilistic structure of society.

This thesis revisits the early concepts of Hillier and looks at the way building morphology and building entrances have themselves an effect on the virtual co-presence and encounters at the street domain. In order to do so, the thesis develops a methodology to examine the micromorphology of the building-street relation, yet one that addresses the syntax of building form: namely, a methodology that addresses architecture (and building morphology) as *'an abstract art which refers to the underlying structure of things'* (Peponis, 1989, p.107) beyond any functional, geometrical and aesthetical programme. The next section discusses how the thesis' scope and aims relate to street activity and urban design issues.

1.3.3. A diachronic process

Discussing the balance between stability and change, Davis (2006, p.16) argues that *'a healthy building culture can change even as it is stable enough to provide continuity'*. Think of the great metropolises, such as London and New York, and of their modest urban past which generated complex realities that still face an unforeseeable future. Growing from traditional row housing settlements, these cities have accommodated and shaped urban life within and without both long-standing and modern building types. And while many of the ordinary buildings of these past urban settlements still survive today, often after numerous cycles of transformations, there are on the other hand newer developments which fail to accomplish longevity essentially because they fail to support liveability and socio-economic sustainability. *Liveability* is a term used to describe the quality of life in urban settings as experienced by people using these settings. While the terms is rather broad and subjectively defined since it depends on people's understanding of urban living experience (Zako and Hanson, 2009, p.130), there are components of liveability that are akin to the generic physical and spatial properties of urban configurations: consider for instance properties of urban space such as the existence of many building entrances facing the street and the high visibility and accessibility of public spaces (Hanson, 2000; Hanson and Zako, 2007; Zako and Hanson, 2009). In turn, liveability itself has an impact on the built environment as well. Indeed, in many cases it is the lack of liveability which compromises the future life of buildings. In London for instance, it was not long after Julienne Hanson's criticism on the morphologies of modernist estates – and their ineffectiveness in supporting the formation of vibrant communities and city life (Hanson, 2000) – that these building complexes started to undergo demolition one after the other. In other words, the fact is that building cultures are changing; the problem is the extent up to which they remain 'healthy'.

An important aspect raised by debates on urban design issues in the second half of the twentieth century referred to the way urban places work and suggested the essence of city living as the vibrancy of life at the street domain (c.f. Jacobs, 1961; Alexander, 1966; Anderson, 1986). These ideas highlighted the significance of *socio-economic sustainability* as another precondition which renders cities as functional places. For instance, in the case of London estates demolition was not the result of the buildings being uninhabitable or obsolete in terms of construction, sanitation or technology; rather, these buildings suffered from their socio-economic condition. The Heygate Estate in south London, designed by Tim Tinker, is an example of housing estate that had a life span of only forty years. Subsequently, it was pointed out that new design attempts lacked something that appeared to be inherent in the surviving historical ordinary buildings: the production of social activity, or urban life, in the street domain.

In the search for factors contributing to urban sustainability, the concept of *diversity* became increasingly acknowledged in literature. Diversity in the context of urban space has many connotations: it may refer to functional mixing (Jacobs, 1961; Campbell, 1999), as much as it can refer to ethnic, social and cultural mixing (Brindley 2003; Hall, 2014). The many faces and patterns of diversity encountered in urban settings became increasingly recognised as a factor for street liveability (Perdikogianni and Penn, 2005) and this set off discussions for the morphological and design parameters that generate diversity (consider, for instance, Jane Jacobs's (1961) four factors for generating diversity: the mixing of primary uses, short blocks and high permeability, the mixing of buildings of different age and high population densities).

In order to advance these observations, empirical urban studies focused on examining what went wrong in the modernist urban design approach which appeared to fail in configuring lively and diverse streetscapes. As Marshall briefly reviews it (2009, p.32-39), the modernist rational thinking in planning was mainly represented in the built urban reality by housing estates: starting from Arturo Soria y Mata's Linear City that suggested dealing with city planning in ways similar to building design (Soria y Mata, 1892), to Ebenezer Howard's Garden Cities programmed through functional zoning (Howard, 1902), and up to Le Corbusier's radical urban conceptualisations (Le Corbusier, 1964) that set forward even more futuristic images of a '*megastructural'* urbanism (Lin, 2007). Applying an analytical perspective to spatial patterns, Hillier explains that in the case of London, housing estates were an act of 'disurbanism' which fragmented space – and hence the virtual community – by *'the breaking of the relation between buildings and public space; the breaking of relation between scales of movement; and the breaking of the interface between inhabitant and stranger.'* (Hillier, 1996, p.131) Moreover, considering the rules of built form aggregation (Muratori, 1959; Conzen, 1960; Panerai et al., 2004), these urban morphologies showed failure to reproduce the qualities of traditional urban building typologies: critiques regarding building morphology emphasise firstly, the loss of historical context (cultural and topological) in modernist design solutions, and secondly, the importance of subdivision and the plot pattern[1] as the 'module' of the aggregated urban complex (Çalişkan and Marshall, 2011, p.383, 385 – after Campbell and Cowan, 2002; Campbell, 2010, p.5). Complementing this work, Hanson (2000) sheds further light on the reasons for this lost street liveability, arguing that throughout the twentieth century, modernist housing solutions created *'small scale, separate, inward facing, unconstituted and hierarchical'* space: a disurbanism of segregated morphologies.

In other words, in the twentieth century cities have in many instances suffered from a pathological inability to generate new socio-economically sustainable building cultures. Apportioning the blame of this to *design* implies effectively the failure of the designer to pre-conceive and/or produce the workings of a functional and sustainable spatial system, tested against time – to understand and address the diachronic processes of urban spaces. In line with space syntax theory, this thesis addresses the lost *art of building* considering architecture as a social art at an abstract, configurational level; as an art that shapes the *spatial culture* of cities (Hillier, 1989). It is suggested that it is this configurational level of design which is poorly understood by architects and planners, leading on many occasions to attempts that aspire to replicate the internal logic of unplanned traditional grids (Neal, 2003; Huxford, 1998; Katz, 1993).

Overall, the literature and practice in urban design suggests that while disurbanism has been largely studied and understood, the remaining inquiry is how to design spaces that will generate and sustain street liveability – and namely, how to understand the role of architecture on shaping the spatio-temporal complexities of the quotidian city. This thesis examines the way urban morphologies contribute to the generation of dense and diverse street activity, and consequently to street liveability over time. As Hillier suggests (1996, p.135) in his 'Reflections on the origins of urbanism and the transformation of the city', *'our interventions in the city can only be based on our understanding of the city.'* This thesis is not a study of disurbanism; rather it looks at the architecture of the 'ordinary' in order to contribute to our understanding of how urban places evolve.

Finally, as Marshall and Çalişkan outline (2011, p.413), within the practice of urban design fall both the architectural, and urban, scales – meaning that *the urban street needs to be understood as a complex entity that interfaces with both buildings and the*

[1] Namely, the properties and arrangement of plots; see Conzen, 1960, p.5.
[2] Smithsonian Natural Museum of History, 'Corals and coral reefs', e-source: http://ocean.si.edu/corals-and-coral-reefs.

urban street network. This fact presents a priori the difficulty of tackling equally the problems of each scale, whilst considering at the same time the relationship of the building and the city domains configurationally.

A *morphological problem*, then, is posed in city building: how to configure built forms which will enhance potentials for street activity. This thesis aspires to develop our understanding with regards to this problem by examining those generic properties of buildings which shape the probabilities for street activity. When considering street activity and the micromorphology of the virtual community, liveability, as well as diversity – as a component of liveability – are akin to the morphology and function of the streetscape at the ground floor level. In other words, a study of the density and diversity of the virtual community implies looking at the properties of the street domain – of both buildings and streets – which relate to the probabilistic patterns of encounter and co-presence. At the same time, a *morphological challenge* is set: that of supporting street liveability over time; namely, of identifying those properties of urban morphologies and configurations that manage to support and sustain the needs of the continuously shifting urbanities. This thesis aims to improve our understanding of this challenge by looking at diachronic processes, at patterns of change and the historical interplay of building morphology and street network. In order to address these two lines of inquiry, analysis is applied to two contrasting urban areas whose historical built form has faced varying urbanisation challenges: Islington, London and the West Village, Manhattan.

The following section defines the research questions to be pursued by the methodology and analysis of specific case studies. The overall aim is to examine the concept of *probabilities* in architectural and urban morphology and its potential implications for spatio-temporal phenomena over time.

1.4. Probabilistic built form

1.4.1. The morphological problem

The first set of research questions concerns the role of built form in shaping street activity. In order to understand how to design a morphology which will support – or even generate – a lively street domain, it is essential to understand the latter as the product of both buildings and streets, of both the micro and macro city scales. From this point of view, the following basic questions need to be addressed:

- *Is built form a background to street activity? If not, how does it affect street activity?*
- *Is the street network a background to street activity? If not, how does it affect street activity?*

With regards to the second, space syntax theory and research have established the relationship between the properties of the street network and pedestrian movement flows, as well as the economic activities taking place along streets (Hillier et al., 1993; Hillier, 1996; Hillier and Vaughan, 2007). Here the study aims to explore further the relationship between street network and morphological and functional diversity at the block scale.

1.4.2. The morphological challenge

The second set of research questions addresses the role of change as an external force which shapes street activity over time. Over time, streets can maintain their morphological and functional properties, or they can present change at different scales (the building scale, the block scale or even the district scale) and in different modes (building demolition or alteration). Looking at varying patterns of urban change in the street interface, the following fundamental questions need to be addressed:

- *Does built form play a role in the patterns of morphological and functional change in the streetscape?*
- *Does the street network play a role in the patterns of morphological and functional change in the streetscape?*

Overall, the hypothesis underlying this research is that there are building morphologies that can render a place adaptive and functionally and socially sustainable over time; and more particularly, that a generic property of these morphologies is the active relationship with the street domain – or in other words the frequency in building-street connections. Finally, the study aims also to explore in this way the micromorphology of street parts that have grown diverse over time, in order to draw insights regarding the spatial and physical properties that allowed for morphological and functional diversity to emerge.

1.4.3. Like reinhabited coral reefs – and the survival of the fittest axiom

This study will explore its research questions on the basis of empirical studies of the urban histories of Islington, London and the West Village, Manhattan. Terraced houses in Islington, and row houses in the West Village, have responded to a variety of socio-spatial changes over time. The proximity of these areas to the London and Manhattan centres respectively enhanced the rapid development of transportation links that increased their own centrality: as the urban grids of both cities expanded, the city networks shifted and the two areas became, consequently, more central. The subsequent higher densities brought morphological and functional change to the areas and created the need for housing to shift from single- to multi-occupancy, and for buildings to incorporate different land uses within the same building shell.

The work of Davis explains extensively the reasons that allowed for the building type of the terraced and row houses to be adaptable in the face of social, economic and technological change. In *The Culture of Building* (2006), the author presents a detailed account of the building culture associated with the architecture of the everyday; craftsmanship, construction processes, technological challenges, the flexibility of the floor plan and its alterations – are all issues related to the morphological and functional changeability of these buildings. Steadman et al. (2000, p.8) also point out the advantages of a highly standardised built form like the terraced house which presents functional flexibility – for instance, the authors note that a terraced house can be easily changed into *'a 'corner shop', an office, a hairdressing salon, a café, even a workshop or warehouse'*. McCormac (1996) also comments on this responsive relationship between form and function in his writing about 'An anatomy of London'. Looking critically at London's long-term development, he shows how the flexibility of the terraced house morphology has encouraged re-inhabitation of generic land uses, so that while a specific use might change, the generic properties of building to street relationships can remain. The author thus claims that London's historical built form acts like 'a coral reef' which enables the incorporation of *shifting* functions over time within a *stable urban structure*. The author uses the metaphor of the coral reef to suggest the *diversity* supported by the terraced house structure: the actual underwater coral reefs are considered 'as the most diverse of all marine ecosystems'[2].

Reflecting on observations by McCormac it is understood that in the case of terraced houses functional flexibility is not the product of designing building form based on specific functional programmes; rather of building form performing in a probabilistic way – not only in terms of its generic building function but also in terms of its structure as built form considered as the aggregate of buildings (Steadman, 2014). Alexander writes on *Notes on the Synthesis of Form* (1964) about the 'Goodness of the fit' that '*every design problem begins with an effort to achieve fitness between two entities: the form in question and its context.'* (p.15). However, when aiming for adaptability a question is raised: how can this fitness be designed to last for shifting requirements and contexts? Hillier (1996) suggests that this question can be answered by the way *'the designer understands the field of formal and spatial possibility'* (p.327). In other words – and to use another term that appeared earlier in space syntax theory (Hanson and Hillier, 1987) – by the way design configures *probabilistic* forms and spaces.

The concept of *probabilistic spaces* appeared in the writings of Hanson and Hillier (1987) about 'The architecture of community'. The authors suggest that the inquiry of design should be the creation of spaces that supports the *emergence of probabilities* in space-time events and virtual social relations, meaning that the patterns of virtual encounters and co-presence are generated instead of being spatially and socially deterministic (as in the case of architectural determinism). This suggestion is in line with 'evolutionary thinking' which considers that a city's future functioning is enhanced through potential and emergence, and not through restrictions and programming (Marshal, 2009, p.257). An important clarification should be made here regarding the tricky differentiation between the '*evolutionary'* and the '*developmental paradigm'*. According to the last, *'the city-organism is a definite (if growing) whole, with subordinate parts functioning for the good of the whole'*, implying that the purpose of planning is to manipulate and guide urban development (Marshall, 2009, p.257) rather than allowing for probabilities.

[2] Smithsonian Natural Museum of History, 'Corals and coral reefs', e-source: http://ocean.si.edu/corals-and-coral-reefs.

While space syntax studies have contributed to the understanding of the workings of spatial patterns, and hence, of *probabilistic spaces* as a sub-category, there remains the question of whether there can be a building morphology that allows for probabilities to emerge and which can support a responsive relationship with its surrounding and wider city context. Accordingly, it becomes of interest to see whether there are any probabilistic principles in those building cultures which have survived for centuries (such as the terraced and row houses which are studied in this thesis). In other words, is it possible to speak of *probabilistic built forms* and if so can we understand how they work?

However, no matter how flexible and adaptive building morphology might be, survival throughout urbanisation is not just simply a matter of being the 'fittest' in terms of building morphology. Firstly, theory and design cannot foresee the multiple forces of urbanisation and the changing modes of living. Karimi (2013) points out the multiple urban challenges of the contemporary world, putting into perspective the major complexities imposed upon design (see also JOSS, Vol. 4, 2013, on the topic of 'Urban challenges'). At the same time the world is seeing a boom in the levels of social networking that transcend physical space (see for instance Vaughan, 2013, on the advent of telecommunications and the implications with regards to physical and virtual networks). Secondly, there are places in cities where social segregation is inherently perpetuated by space itself, namely the street configuration renders these places spatially segregated affecting the formation of the virtual community and of the local 'movement economy' (c.f. Vaughan 1999, 2005; Vaughan et al. 2005; Vaughan, 2007; Carpenter and Peponis, 2010; Legeby, 2013). Considering the key space syntax theories of the virtual community and the theory of natural movement, cities can be described 'as movement economies' (Hillier, 1996, p.111-137) meaning that some locations in the grid have higher potential for more movement by-product and thus higher potential in attracting diverse activities over time; or in other words, in attracting the 'urban buzz' (*ibid.*, p.126). It is then understood that this urban buzz is the generative outcome of urban *processes between both buildings and streets* that feedback on the virtual community.

The following section briefly overviews the wider background ideas and methodologies regarding cities which have guided the approach of this study in examining the micro-morphological processes of the virtual community.

1.5. Cities and methodologies

1.5.1. 'The city as one thing' and the space syntax paradigm

Hillier and Vaughan (2007) discuss the significance of the structural interrelationship of space and society in a paper that summarises the core ideas around which space syntax theory was structured. The authors explain that two sides comprise cities: the *physical city* (namely, 'a large collection of buildings linked by space') and the *social city* (namely, 'a complex system of human activity linked by interaction'). The city's realisation in space and time unifies the two sides in one entity, and it behoves design and planning processes to treat it as such.

More specifically, it is emphasised that, though the programmatic justifications and concepts that came from practice and design imply a more holistic approach in urban matters, the theoretical discourse has tended to focus independently either on the physical patterns of cities or on their embedded social schemes. Even when drawing references from one to the other, this has not been done in a systematic way. In space syntax propositions, the physical city is considered to be the counterpart of the social city, with space being the common ground for both.

In this way, space can be appreciated as more than simply a background to human activity. Instead, its dual agency is brought to surface; space acts both in a *'conservative'* and a *'generative'* way for the city's components (physical and social patterns) and their relations. Namely, physical patterns are both shaped by social contexts (in a sense that they are a reflection of them), and can shape or generate them as well. More specifically, in the first case, space is designed and subsequently used in a '*conservative mode'*, embedding in its layout a culturally defined social pattern, with the aim of reinforcing, of reproducing it. On the other hand, when space is designed and then used in a '*generative mode'*, it gives rise to potential social activity.

All these ideas relate deeply to the research questions that have to do with the impact of physical space – and hence design – on spatial cultures and the subsequent ordering of social relations (Hillier, 1989, 1996; Peponis, 1989). Hand-in-hand with the theoretical framework, the space syntax approach also provides the methodologies to consider space in relation to society. These will be described in detail in Chapter 4.

However, this thesis defends the view that the space syntax approach is not sufficiently developed to deal with the *street interface* and its *micromorphological* complexities – which is largely because there is not enough research to support this assertion.

1.5.2. Process typological and historico-geographical approaches

A precise definition of urban morphology is still debated (Conzen, 2013, 2014; Kropf and Malfroy 2013), but in general, Conzen's definition summarises the aspects of the field relevant to this study: *'urban morphology is the study of the built form of cities, and it seeks to explain the layout and spatial composition of urban structures and open spaces, their material character and symbolic meaning, in light of the forces that have created, expanded, diversified, and transformed them'* (Conzen, 2013; 2014).

Urban morphologists have defined techniques to systematically study building typologies and townscapes at the building, block and urban scales. The space syntax approach mentioned earlier is considered as one of the four approaches of urban morphology (Kropf, 2009), the others being: the spatial analytical approach (see the work of Michael Batty), the process typological approach (the Muratiorian[3] tradition continued by Gianfranco Caniggia; see Cataldi et al., 2002) and the historico-geographical approach (the Conzenian[4] tradition). The ideas and thinking supported by process typological and historico-geographical approaches are also particularly relevant to this research, for a number of reasons. Firstly, these approaches identify the need to acknowledge the effects of time and hence the necessity of historical studies. Secondly, they also accentuate the importance of cross-cultural studies while at the same time they highlight the need to understand urban phenomena within their specific context (Conzen, 2013). Moreover, urban morphology emphasises the relevance of land use studies in understanding cultural continuities in the urban landscape over time. Finally, in describing the origins and development of the British urban morphology and the Conzenian tradition, Whitehand (2001) includes the field of 'micromorphology' as a current thematic research branch deriving from the Conzenian approaches.

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[3] i.e., after the Italian architect Saverio Muratori.
[4] i.e., after one of the 'fathers' of British urban morphology, MRG Conzen.

Although this thesis does not present a fully Conzenian study (as it does not discuss issues like morphogenesis; Conzen, 1966, 1988, 2004), it has innovated in integrating Conzenian units of a street, plot and land-uses into a configurational framework. The thesis suggests that we can be assertive about the configurational properties of building morphologies in order to examine architecture at a micro-morphological scale that allows us to rethink the generic aspects of built form together with all the implications for activity, function, and design.

1.5.3. The evolutionary paradigm

There have been many efforts in the body of theoretical discourse to apply biological metaphors to cities. The problem with metaphors is that they impose a model of interpretation which is pre-conceived in a different context and does not emerge by the object of study itself (here the city), hence the correspondence of description through that model is questionable (Hillier et al., 1976). This thesis is informed by specific ideas relevant to evolutionary thinking that mainly refer to the ways of addressing *complexities* – but neither the perspective nor the methodology of the thesis are based on biological metaphors *per se*.

Using as starting point the original ideas developed in Patrick Geddes' book *Cities in Evolution* (1915), biological metaphors attempt to draw references between cities and living organisms; in other words to approach cities as 'organic wholes'. However, these metaphors mainly imply a detailed equivalence of *urban* to *biological* phenomena (Kropf, 2009; Marshall, 2009), and these theoretical cross-disciplinary ideas remain restrained to notions of cities as organisms, instead of taking into consideration the more general, wider contexts of biological systems. Marshall (2009) suggests instead that an evolutionary paradigm should treat the city as an 'ecosystem' considering that the relations of urban components are partly cooperative and partly competitive. It is of interest to explore whether this is the case for buildings and streets as fundamental components of the physical and the social city.

Moreover, Marshall discusses that the *'order of the whole arises from the interactions between the parts'* (2009, p.17-18). Jacobs has also suggested the importance of the parts-whole relation (1961, Chapter 22, p. 428-448) and that the problems presented in cities should be addressed through *inductive thinking* and *thinking of processes*. Inductive thinking refers to the retrieval of information concerning the complex 'whole' through the study of its sub-components; namely, to a bottom-up approach.

Consequently, when it comes to understanding cities, inductive thinking comes from studying the 'urban parts' in order to decode the structure and operation of the 'urban whole' (Hillier, 1992). On the other hand, based on ecological ideas the Chicago School seek to retrieve insights regarding patterns from the study of processes instead of jumping from observations about patterns into conclusions about processes (c.f. Burgess, 1924; Davie, 1937; Levin, 1992; Catton, 1993).

Understanding urbanity, within such an evolutionary scope, brings the discussion to two key notions: *resiliency* and *adaptivity* (Batty and Marshall, 2009). Batty and Marshall argue that *'the city is a well-ordered working system, resilient to a degree and adaptive in the sense that external and internal pressures lead to readjustment that continues to keep the system functioning.'* (*ibid.*, p.569). It is indeed within the affiliation and counterbalance of continuity and change, where the analogy with evolution arises (Marshall, 2009). More explicitly, evolutionary processes clarify how things become differentiated, but still relate to each other in the space-time continuum. In this sense, resiliency – which can be traced throughout historical processes – refers to the self-maintenance of the urban system. And accordingly, adaptivity is defined by the context of the urban whole and it has *'fit-for purpose'* nature (*ibid.*, p.14). In other words, evolutionary thinking implies that the system itself adapts automatically to shifting conditions in a responsive manner relevant to its *particular* context. These ideas relate to *continuity* and *change* in urban space and emphasise the need to acknowledge their complementary nature (Karimi, 1998).

Overall, evolutionary thinking points out three guidelines for this research:

- to consider the interplay of built form and street network;
- to consider the interplay of parts and wholes and the interaction of scales; and
- to consider historical processes and the particular morphological and configurational context of urban space.

1.6. Research Objectives

From a general point of view, the study aspires to contribute to our understanding of the way street life is shaped by the emergent pattern of built form and spatial layout. The aim is to approach this topic in a systematic and analytical way in order to provide evidence-based insights for urban designers (Karimi, 2012). In addition, aspects of liveability and diversity are revisited to reassess the theoretical suggestions of the 1960s, particularly Jacobs' conceptions as discussed in *The Death and Life of Great American Cities*. This is in line with suggestions by Marshall (2012) for potential ways forward for urban design as a scientific discipline. Finally, the research aims to build on recent steps in the field of space syntax that have opened up an intradisciplinary exchange with the field of urban morphology (Griffiths et al., 2010; Vaughan et al., 2013). The thesis supports with evidence from the research delivered Davis' views that the various approaches on urban morphology *'together offer coherent insights that none of them do individually'* (2014, p.171).

Within the specific scope of this study, this research suggests and tests ways of studying in high-resolution the micro-relations developed at the street domain. The thesis aims to engage researchers in applying micro-morphological studies, by providing both *concepts* and *analytical methods* to work with in the future. The objective is to provide evidence that the architectural and urban scales must be understood together in order to achieve integrated urban design solutions. Notably, the purpose is to show that city building needs to be historically, culturally informed and fitted-to-the-case. Finally, as an overall endeavour, the selection of this topic and its approach aims to highlight that 'syntax' is something not traced only through the spatial logic of street patterns, but is something that underpins the rules of built form aggregation as well.

1.7. Thesis Outline

The thesis opens by introducing the theoretical ideas relevant to the topic (Chapter 2). In Chapter 3, the selection of the particular case studies, Islington and the West Village, is justified and the urban backgrounds of London and Manhattan are overviewed in terms of the building culture. Chapter 4 will introduce and explain the particulars of the methodological approach. The two next Chapters (5 and 6) present the main body of the analysis of data collected from the two case studies. Chapter 7 composes a comparative consideration of the data collected from the two areas in search of any generic implications regarding the historical interplay of built form and street network. Finally, Chapter 8 forms the concluding discussion, detailing how this research contributes to knowledge, the novelty and limitation it presents, and the potential prospect for future research objectives.

2

Chapter two - Encounters and the ‘field of probability’

This chapter develops the theoretical trajectories of this thesis bringing to the table ideas, concepts and studies relevant to the research topic. The discussion is centred on the general themes of *encounters* and *change* in urban space. The aim is to specify firstly, which theoretical discourses and analytical approaches have shaped and informed the study and where gaps emerge in the existing knowledge that this study can inform; and secondly, the way the study here aspires to build, contribute or feedback on them. Finally, any terminology which is considered relatively ambiguous is clarified based on the way it is used within the context of this study.

2.1. Trajectory one: encounters

2.1.1. The virtual community

The first core issue examined in this thesis is the complexity of the virtual community, when the nature of building-street interfaces is considered. This inquiry aims to discuss the role of building patterns in configuring a ‘sociable’ street environment. As with most – if not all – phenomena which are akin to the complexities of human behaviour, the notion of ‘sociability’ bears an inherent subjectivity to interpretations. However, it is the scope of this study to address the generic aspects of building complexes which potentially relate to the social activity manifested at the street domain; namely, the elementary properties of built form which impact on the *virtual* sociability of the street interface, prior to any anthropological, sociological, phenomenological etc. implications. In this sense, the concept of the 'virtual community' is fundamental for this research.

As mentioned, the concept of the virtual community was introduced by Hillier et al. (1987) in 'Creating life: Or, does architecture determine anything'. Hillier (1989) in his article 'The architecture of the urban object' develops further the concept. It is important here to quote Hillier's words as they address the essence of this study:

> 'Spatial form, I argue, creates the *field of probable* – though *not* all possible – *encounter and co-presence within which we live and move;* and whether or not it leads to social interaction, this field is *in itself an important sociological and psychological resource.* I will try to show that this field has a definite structure, as well as properties of *density* or *sparsity*. It therefore deserves a name. I will call it the *virtual community*, meaning that it exists even though it is latent and unrealized. The virtual community is the *direct product of spatial design*.' (*ibid.*, p.13).

In other words, Hillier suggests that for any social interaction between the users of a space to occur, there is the primary need for the users to encounter one another, to be physically co-present. The author goes on to argue that there is a correspondence between the way space is structured and the potentials for encounter and co-presence of (physical) users within that space. The virtual community is essentially the potential patterns of encounter and co-presence that stem from urban *configuration*. Goffman (1963) and Giddens (1984) have also attempted to define encounters and co-presence. For Goffman the discussion on encounters is absorbed by the *face-to-face* encounter patterns and the social implications of micro-spatial engagements. Giddens develops his ideas on co-presence in a relevant notional stream with Goffman, in the sense that for both authors co-presence '*is anchored in the perceptual and communicative modalities of the body.'* (Giddens, 1984, p.67) Both these conceptualisations lack a formative link between *space* and the *body*; one that does not treat space as an 'inactive' background to human activity. It is the notion of *configuration* which takes into account of these *formative* relations between space and society that give rise to socio-spatial probabilities.

In space syntax theory, *spatial configuration* is understood as meaning 'spatial relations which take account of other relations within a complex'. Configuration exists both as an unconscious understanding that comes to individuals as they walk through and experience the urban environment, as well as a conscious level of 'analytic knowledge' which stems from the decoding of the abstract structures of spatio-temporal phenomena through spatial analysis (Hiller, 1996, p.29). In space syntax theory configuration is accepted as inherently non-discursive, in that we do not have an everyday language for describing how city parts are put together. It follows that in order to understand urban spatio-temporal events, one needs, as Hillier has proposed, an understanding of the *non-discursive* configuration of urban places (1996, p.27-29) – or in other words, of generic properties of spatial systems.

The theory of 'natural movement' brings together the ideas of virtual community and spatial configuration (Hillier et al., 1993), suggesting that the structure of the urban street layout is a primary agent in distributing potential pedestrian movement patterns. Numerous space syntax studies – now covering many years, across varying urban environments – have indeed confirmed the relationship between spatial configuration and distribution probabilities of users within spatial systems (c.f. Hillier and Vaughan, 2007; Karimi, 2013).

Notably, the majority of empirical space syntax urban studies have indeed focused on examining the emergence, the effects and by-products or implications of 'natural movement'.[5] However, returning to Hillier's propositions in 'The architecture of the urban object' (1989), one finds that there is more to explore in order to grasp the workings of the virtual community. In his discussion, Hillier suggests three types of law which confine urban form (*ibid.*, p.6): laws of the urban form itself; laws that are assigned by society to the urban form; and finally, laws that pass on from the urban form to the functioning of society. The author goes on to suggest that *space* is the sole architectural element (considered amongst construction and style) which bears all three laws. In explaining the spatial properties that are related to each law, Hillier clarifies that *spatial configuration* essentially itself generates the third law and the structure of the virtual community (*ibid.*, p.13). Space syntax literature has contributed

[5] Of course, there are other research streams of urban analysis in space syntax, such as studies addressing the generic form and structure of cities (see Hillier et al., 2012); the conceptualisation of cities (see Psarra, 2013); or studies for developing software and new analytical measures (c.f. Al_Sayed et al., 2012; Hanna, 2012; Karimi et al., 2013; Hanna et al., 2013; Varoudis et al., 2013; Ye and van Nes, 2013) and for shaping decision-making in the design process (Law et al., 2013).

in examining the way *street configuration* generates the probabilistic field of encounter and co-presence, but the role of *built form configuration* as another structural parameter of the virtual community remains a question. Hillier's third law of the urban object holds an important implication concerning the inquiry of this thesis which investigates the potential impact of building morphology on street activity: the third law implies that in order to understand the impact of built form on the functioning of the street interface (the object of study here), then building morphology needs to be studied *configurationally*.

If we accept that the structure of the virtual community is a spatial product, then it becomes understood that the virtual community – like space itself – is affected by all three laws; namely, encounters and co-presence are also shaped by the spatial (first law) and socio-spatial (second law) properties of settlement morphology. In settlement morphology, there are two fundamental entities which define space: the built form and the open space. It is suggested here, that when considering the virtual community, we cannot exclude the role of either of these two entities. If we assume physical users in spatial patterns then these would occupy both the open space and the building cells. There is therefore another formative agent which shapes user encounters and physical co-presence in urban space: the buildings and their connection to the street, namely the *building entrance*. The building entrance is a probabilistic point for interior-exterior encounter. In this sense, the building entrance as well *configures* the virtual community; and it is via the configuration of *building entrances* and *potential thresholds* that the building morphology shapes the virtual activity at the street domain.

This is not a new idea within space syntax theory, though it is a relatively neglected one. The importance of the building entrance is evident when looking at the way settlements are originally formed. In *The Social Logic of Space* (Hillier and Hanson, 1984, p.18), the 'elementary cell' was defined as the simplest spatial and social structure. The elementary cell has an inside space, an outside space and a link between the two: the entrance. It follows that the numerous ways in which the elementary cell is aggregated to form the 'beady ring' structure of settlements is *defined* by building entrances, i.e., an accumulation of building cells while entrances are left free to face open space (Hillier, 1989, p.7). In *The Social Logic of Space,* Hillier and Hanson (1984, p.143) note: *'A settlement, as we have seen, is at least an assemblage of primary cells, such that the exterior relations of those cells, by virtue of their spatial arrangement, generate and modulate a system of encounters.'* This is a *genotypical spatial property* of settlements (*ibid.*, p.9). This idea in turn relates to the first law and the rules applied to urban form by its own morphology and spatial logic. Hillier expands this simple concept by saying that *'virtually all, not just some, spaces in the settlement are, in a sense, under the control of entrances and potentially, of people who may come and go through them'* (*ibid.*). This relates to the second law and the rules applied to urban form by society (namely, rules that make space socially functional). From these observations, it can be conjectured that the potential of people coming and going through entrances defines in turn another field of probable encounters and co-presence, besides the one generated by the street configuration (Hillier, 1996, p.135, 141). Whereas the actual space where the encounter occurs is the *threshold* between interior and exterior (between building and street), it is understood that open space is either the origin or the destination of the encounter; in any case, buildings themselves participate in the generation of probabilistic encounters in the street domain. Or, in other words, they participate in the formation of the virtual community.

The role of building morphology in the formation of the virtual community has been addressed by Julienne Hanson in 'Urban transformations' (2000). Hanson's work consists a key study within the space syntax field which highlighted, with the use of analytical methods, the importance of 'street based housing'. Hanson argues that housing estates *'produced observable, quantifiable perturbations in the field of co-presence that we call the virtual community'* (*ibid.,* p.120). A few years earlier than Hanson's publication on housing estates and issues of architectural and urban morphology which related to street liveability, space syntax theory was introduced to *Space is the Machine* – by Bill Hillier in 1996. This publication represented a rather different point of departure with an increasing interest in large scale urban modelling. After Hanson's studies, the role of building morphology in generating potential encounters in urban space remains underexplored within the space syntax field. Indeed, this fact can perhaps be justified by the assets that space syntax theory and its analytical tools show for large scale urban studies. Space syntax techniques have provided an intriguing chance to gain insights regarding large spatial complexes and scales that are more difficult for the human mind to process and conceptualise, such as the workings of a whole city. In *The Social Logic of Space* (Hillier and Hanson, 1984) it is characteristically mentioned that *'[s]ettlement space is richer in its potential, in that more people have access to it, and there are fewer controls on it. We might say it is more probabilistic in its relation to encounters'* (p.19). To reverse this idea, encounters generated by the built form are more tangible and finite within the physical dimensions of buildings.

However, no matter how tangible or restrained the field of probable encounters generated by the built form is, this does not imply that its impact on the socio-spatial entity of the street domain is well understood. On the contrary, architectural and urban practices have on numerous occasions exhibited neglect, misconception, awkwardness, or even failure, in tackling the production or re-production of a building-street configuration that supports potential for co-presence and encounters (Hanson, 2000; Marcus and Legeby, 2013; Legeby, 2013). If we accept that co-presence and encounters are a precondition for social interaction to occur, then it can be said that what remains obscure is how to design built form that supports or even triggers probabilistic co-presence and encounter fields. It is therefore suggested that any insights concerning this crucial aspect may be helpful for architects and urban designers aiming to address city building within the scope of contributing to the social sustainability of urban places.

2.1.2. Interior-exterior encounters: the making of

In order to examine the organisation of the interior-exterior encounters established by the built form, we must firstly understand the way built form is put together in urban space. Namely, we must refer to the organisational rules of the way building units are aggregated to compose the urban form. In general, within the various schools of urban morphology (Kropf, 2009), one can trace many different representations and conceptualisations of the way in which urban form can be broken down to elementary components. These are dependent on the question and urban phenomena addressed; namely, of the units or components and of their relations being under consideration (Marshall, 2009, p.60-68). For Marshall (2009, p.60-68), the term *'component'* is considered as something more general than the term *'unit'*. *Component* implies being part of something, either referring to units or to sub-units. A *unit* is something *'atomistic'*, without though implying equivalence to *'the smallest possible constituent element'*, rather something that if divided, its *'integrity and functionality'* would be destroyed.

With regards to the aggregation rules of urban form which relate to the issue of interior-exterior encounters in particular, we can refer to the following relevant morphological readings of settlements – coming from different urban morphology approaches or 'schools' (Kropf, 2009): firstly, 'the pertinent strip', as described in the process typological approach (Caniggia and Maffei, 1979; 2001, p.125); and secondly, 'the plan-unit', as described in the historico-geographical approach (Conzen, 1969, p.3-5).

Caniggia and Maffei (1979; 2001), in their description of building aggregates (p.118-160), define the pertinent strip as *'the area inherent to each route that contains the building lots that face it and are served by it'* (p.125). The idea of the pertinent strip is relevant to the study here in that it considers the array of 'built plots' (essentially, of buildings) which face the same street as one unit. Namely, it acknowledges different parts within the block area, according to where the buildings are facing (namely, according to the block sides). In this way, the building is tied to the street domain it is facing. At the same time, the pertinent strip considers the depth of the built lot (namely, of the lot area covered by building); consequently, a change in the built lot depth implies a change in the pertinent strip, regardless of whether or not the lot width is the same. In that sense, the study here is *not* a study of the pertinent strip (although it is informed by it). This is because the feature of depth is not considered to be of relevance when examining the interior-exterior encounters, since the building-street relation is shaped by the front of the house and the building façade.

Conzenian approaches in urban studies have fundamentally contributed to a morphological reading of the built environment (c.f. Conzen, 1960, 1966, 1988; Conzen, 2014). The topic of encounters and co-presence is foreign to Conzenian thinking. However, this thesis establishes on the one hand the relevance of Conzenian methodology to studying building-street encounters, and suggests on the other hand that these notions of encounter and co-presence are a necessary input to the study of urban morphology in order to address the space-society problem. In the Conzenian tradition (Conzen, 1969, p.3-5), the concept of the plan-unit is used to distinguish between varying settings of the three plan-elements: the streets, the plots and the block-plans (i.e., the building plan situated in the block layout). This idea of looking simultaneously at the building structure in relation to the block layout and the street pattern is a strong concept of the Conzenian morphology which has relevance to the notions of encounter. This thesis advances this morphological idea in order to explore configurationally the *aggregation rules* applied to the *street interface*; to explore, in other words, whether/how building morphology relates to the configuration of building entrances, and subsequently, of probabilistic interior-exterior encounters.

Overall, across the many branches of urban morphology, the basic components of urban form are similarly identified: the building, the plot and the street (Conzen, 1960, 1968; Caniggia and Maffei, 1979, 2001; Kropf, 1996, 2011; Marshall, 2009; Çalişkan and Marshall, 2011). The importance of built form aggregation rules in creating urban spaces of different qualities is also established (Muratori, et al., 1963; Conzen, 1960, 1968; Kropf, 1996; Panerai et al., 1997, 2004). Subsequently, a final insight regarding building aggregation rules refers to the specification of the *module* of the aggregate when studying building-street encounters. When looking at the block scale, Caniggia and Maffei specify that the module is the lot; Conzen also identifies the plot as the constituent element of the plot pattern. When describing the origins of the urban block, Hillier (1989, p.7) suggests a relevant aggregative process where the rules are applied to *'elementary units* [notional dwellings] *with open space on the entrance side'.*

However, there are limitations of the Conzenian analysis as it stands when analysing building-street encounters in that the plot (or lot) is only partly relevant. Firstly, the plot's width is in particular the most relevant plot property to an array of building-street encounters, since it provides a relative measure of the building façade (namely, the façade width will be equal to or smaller than plot width). Secondly, the number of entrances per plot is not a fixed feature; on the contrary, it is a property independent of the building or plot width, i.e. there are equal possibilities for narrow façades with many entrances on the one hand and long façades with very few on the other. Therefore, when looking at the pattern of building-street connections within a block front, it is not necessarily the case that a *module* is required. What is indeed required is a measure of the frequency in which entrances appear within the block front. The *module* can then be considered in terms of door spacing, namely in terms of how closely together the interior-exterior encounters are arrayed. Such a module could then provide a reference point to compare block sides with regards to the interior-exterior encounters they generate. These solutions are further discussed in the methodological approach where the thesis brings the historico-morphological perspective on urban form into dialogue with the syntactical perspective.

The study of spatial relations at the level of the plot falls within the research stream of urban morphology called 'micro-morphology'. Whitehand notes (2001, p.106): *'The recognition of a sub-field of urban micromorphology is little more than acknowledgement that much analysis needs to be undertaken at the scale of the* *individual plot or indeed within the individual plot.'* Returning to the ideas discussed by Hillier and the concept of the virtual community, it is suggested here that the virtual community has a micro-structure as well which is defined by spatial relations at the level of micro-morphology. Whitehand considers the concept of the micromorphology in terms of morphogenesis; more specifically, in describing clusters of morphological change recorded at neighbouring plots which might lead to building transformations. This thesis aims to show how urban micromorphology has a *structural* role to play on the street interface, in both *synchronic* and *diachronic* urban processes – and that it becomes a powerful concept when considered in terms of the virtual community.

2.1.3. Boundaries, thresholds, interfaces

The differences between what is considered as *boundary*, *threshold* and *interface* need to be clarified at this point.

The nature of a *boundary* presents the fundamental property of disconnecting – and simultaneously defining – two domains; the domain that it encloses (interior) and the one that surrounds it (exterior) (Hillier and Hanson, 1984, p.144). There are also conceptions of the term boundary which are about subjectivities (see Kirby's 'indifferent boundaries', 1996) and discuss the implications of boundaries in varying, and often ambiguous, dimensions – such as the body or projections of identities and of one's 'self' (Kirby, 1996, p.36). The study here aims to focus on the spatial dimension of the notions of *boundary*, *threshold* and *interface* starting from very generic conceptions of encounter – prior to any anthropological or phenomenological sense. Besides the physical division, the boundary also constitutes a primary social division within the virtual community: it separates the users of the internal structure (in *The Social Logic of Space* referred to as the 'inhabitants') from the users of the external domain (the 'strangers'). However, the notion of a boundary does not necessarily imply the existence of a link between the two divided domains, of an entrance. In turn, the potential interaction of the divided domains depends on the existence of *thresholds* within the boundary configuration and the possible role of the boundary as an *interface*.

Respectively, when understood in generic spatial terms, the notion of the *threshold* implies *'not only the boundary between inside and outside but also the possibility of* *passage from one to the other'* (Eliade, 1959, p.18, 25). Namely, thresholds are those spatial locations of the boundary where there is potential accessibility between the interior and exterior domains. For instance, in buildings examples of thresholds are doorways, porticos and stoops. These locations are potential areas in the boundary configuration where the act of transition from one domain to another can take place.

The *interface* is possibly the most complex notion to grasp, since its fundamental property is the allowance of interaction between the separated domains. However – in contrast to the notion of threshold – this interaction does not imply the potential for accessibility as well. Instead it suggests a connection (in the sense of a reference to its content) performed through accessibility, visibility, or both, or even just through a contextual connection. In other words, whilst threshold implies transition and therefore a change of 'status' for the user[6], this is not necessarily the case for an interface. An interface lies within the boundary domain, with the possibility of being just a location (but not necessarily an entrance, or threshold) or of extending to its whole length, in which case the entire boundary constitutes an interface. Furthermore, it could be simply an element that visually or contextually connects activities performed within the bounded system to the activities of its surrounding environment (by providing, for instance, visual or textual information about the function of the interior). A threshold could also be a space with a substantial width, where an activity of interaction (that relates to both domains and their users) can take place. In other words, a threshold is a potential interface; but an interface is not necessarily a threshold. Also, an interface can be part of a boundary, but a boundary does not necessarily represent an interface. Clearly, a building boundary is most likely going to constitute an interface at some parts of its configuration and to present at least one threshold.

In space syntax literature, the notion of the *interface* has been relatively ambiguous and has been subject to many interpretations and contexts (see the discussion by Koch, 2013 on how the architectural interface – namely, the interface between users of the building interior – is conceived in space syntax studies). For instance, Hillier in *Space is the Machine* writes, with regards to a building's interface (1996, p.198):

> *'An "interface" is a spatial relation between or among two broad categories of persons (or objects representing persons) that every building defines: inhabitants, or those whose social identity as individuals is embedded in the*

[6] That is, users switch from being users of the interior into users of the exterior; from 'strangers' to 'visitors' or 'inhabitants' to 'strangers' (and vice versa).

> *spatial layout and who therefore have some degree of control of space; and visitors, who lack control, whose identities in the buildings are collective, usually temporary, and subordinated to those of the inhabitants.'*

Earlier, in *The Social Logic of Space*, Hillier and Hanson use the notion of interface to describe the wider socio-spatial context of a settlement (1984, p.17):

> '…*we were treating the public space of the settlement as a kind of interface between the dwelling and the world outside the settlement, the former being the domain of inhabitants and the latter being the domain of strangers. How this interface was handled seemed to be the most important difference between one type of settlement and another'*.

Although related to spatial structures, in these previous statements the idea of the interface is presented as something vague and formless, as a spatial effect rather than something that has a spatial form itself. In his talk at a plenary session in the *Eight International Space Syntax Symposium*, Peponis clarified his consideration of interfaces as:

> *'[…] the creation of different spatial conditions and their relationship, whether this is defined at one location or threshold or across multiple locations distributed over a design as a whole'.*[7]

This definition begins to narrow down the notion of the interface to a more *spatially* defined context. By emphasising the 'spatial conditions and their relationship', this conceptual approach focuses more on the morphological and physical elements that define spatial patterns, in terms of the properties of the built volume and built form. In this sense, the notion of the interface becomes more tangible as a physical space and hence can be explored, understood and addressed by design. Therefore, the study here discusses interfaces within the spatial and physical dimensions of the term contributing to this notion which is too often used too loosely.

In Peponis' definition there is the acknowledgement that a spatial interface has different scales: it can be a location, a space or a series of locations. Based on this acknowledgement, the study here defines and discusses the following *spatial interface scales*:

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[7] Quoted from Peponis's Plenary Session in the 8th International Space Syntax Symposium, January 2012, Santiago, Chile: (e-source) http://vimeo.com/35709228

- *Building-street interface*: considered as the space from the building façade (including the three-dimensional surface of the building façade and potentially the activity behind it – whether the activity is visible or implied otherwise) to the street domain (including the pavement configuration and its micromorphology[8]).

- *Block-street interface:* considered as the aggregate of building-street interfaces facing the same street segment side.

- *Street interface*: considered as the aggregate of building-street interfaces facing the same street, including both sides of the street and the open space between.

Finally, looking at building-street interfaces assumes an understanding of both the building and the street structure. As Bobic specifies, an *urbanity interface* is *'a space on edge, where a myriad of interactions between public and private domains are played out, shaping its development, use, meaning, spatial forms and territorial framework'* (2004, p.16). What is explained by this definition is that the existence of an interface has an impact on the form and function of the overlapping domains, and vice versa: the overlapping domains have an impact on the interface. On the contrary, the presence of a boundary does not necessarily involve an interaction between the separated domains – and hence, a potential impact on their structure. Indeed, it might even be the case that the purpose of the boundary is to restrain the exchange of references between the bounded and external systems. As Hillier and Hanson explain (1984, p.146), this reflect the *'dual nature of the boundary, which at one and same time creates a category of space -the interior- and a form of control – the boundary itself'*.

Overall, the study looks at varying street interfaces – considered as the sum of building-street interfaces and develops configurational descriptions and measures of the micromorphology of the virtual community. The following section explains which properties of the street interface are addressed by this research in particular.

[8] For instance as part of the pavement micromorphology we could include an array of trees.

2.1.4. A streetscape of encounters

If we consider that the streetscape is essentially the substance of cities then it is understood that addressing the formation of the streetscape as a spatial, physical and social entity is a rather complex problem (c.f. Whyte, 1957; Jacobs, 1961; Gehl, 1971; Appleyard, 1981; Anderson, 1986), and indeed a problem that cannot escape associations with culture and time (Whitehand, 2012). In reality there are numerous associations and factors that affect social activity at the street domain, such as cultural, psychological, cognitive, the configuration of the third dimension and the visibility relations. Many studies have addressed the visual complexities of the streetscape: Tucker et al. (2005) suggest a method for analysing the visual streetscape and summarise previous ideas on the subject (c.f. Lynch, 1960; Berlyne, 1974; Rapoport, 1990; Kropf, 1996). Other studies have addressed the relation of private and public space, such as Newman, 1972, 1981; Fiske 1987, Alexander, 2003. Papamanousakis (2009) has looked at building façades and functions with regards to the shifting street profile throughout the time-span of everyday and night-time activities. All these are aspects of the streetscape complexities and relate to micro morphological properties and consist liveability factors.

To narrow this problem down and frame it within the scope of this study, the research here addresses the streetscape in terms of the way the virtual community is structured by local (micromorphology) and wider city forces (spatial configuration). This scope is essentially related to the way design at the building and city scales can affect the social activity taking place in the street at a very generic level. In other words, the study here looks at a very particular, yet generic, property of the streetscape: the potential for encounters to occur in the street domain; encounters both shaped by the buildings adjacent to the street and by the function of the street network. In this sense, the streetscape is studied in terms of potential accessibility relations at the level of the ground floor, namely at the street level where users' encounters and co-presence spatial patterns when manifested they can contribute to street activity.

This research is largely inspired by Julienne Hanson's influential article 'Urban transformations: A history of design ideas' (2000). In 'Urban transformations', Hanson compares the properties of the historical built form with modernist redevelopments in Somers Town, London. Her study raised important implications with regards to the way built form has an impact on the urban streetscape and indeed provided feedback to design practice (particularly with regards to the modernist housing spatial complexes). Hanson combines space syntax techniques and morphological readings to achieve a spatial and physical examination of the built environment and the social relations it supports. Notably, the author develops new measures relating to the number and frequency of entrances per spatial unit in order to do so.[9] More recent space syntax research regarding aspects of street liveability – such as safety – has also addressed the way local encounters are structured by the building-street interface (Shu, 2000a, 2000b; Hanson and Zako, 2007; van Nes and López, 2007, 2010). The study here, advances these approaches methodologically, firstly in that it looks at the micromorphology of the street interface at a greater detail by studying street segment *sides*, namely looking at each side of the street separately; and secondly, in that it studies the configuration of the street interface historically.

Hanson defines some fundamental properties regarding interior-exterior encounters. Decoding the building-street transition, the author notes that building entrances can constitute either *primary boundaries* (direct entrances at the building line) when accessibility between the building interior and the street domain is direct; or *secondary boundaries* when accessibility is indirect (according to Hanson, 2000; Hanson and Zako, 2007). It is conjectured that secondary entrances increase the element of privacy and protection of the building interior by adding distance between the public street domain and the private building entrance. The private-public distinction is often further emphasised with visual barriers, such as low/high walls or fences. In contrast, primary entrances imply proximity to the public realm due to direct accessibility from the street to the building interior. Based on the aforementioned distinction between boundaries, thresholds and interfaces, the study here uses for consistency the term ‘primary and secondary *entrances* (or *thresholds*)’ to describe transition, rather than the term ‘boundary’ which is used by Hanson.

In their study on ‘Communities of co-presence and surveillance’, Hanson and Zako discuss ‘natural surveillance’ as the product of spatial and morphological properties of urban systems (2009). Recalling Foucault (1975) the authors highlight the implicit ‘power’ of surveillance over human behavior; earlier, also Jane Jacobs has suggested that ‘eyes on the street’ consist a pre-requisite for safety on sidewalks (1961, p.35). In their research, the authors analyse inner city areas in London, Manchester and Sheffield. The study results identify traditional and post-modern streets as urban

[9] E.g. *constitutedness*: the percentage of convex spaces that are constituted by dwelling entrances, and *neighbourliness score:* the average number of dwelling entrances per constituted convex space (Hanson, 2000, p.104).

settings that promote natural surveillance (p.18). Hanson and Zako explain that post-modern developments have managed to overturn the modernist enclosure with the implementation of design principles that acknowledge the importance of *'both space occupancy or co-presence and space observation or surveillance'* in creating lively streets (p.19). The results of this study suggest that a critical factor for liveability at the street domain is the type of the building-street transition (direct/indirect) as being a fundamental property of the building-street interface, since it defines the immediacy – physical, and consequently social – of interior-exterior encounters.

2.2. Trajectory two: change

This section aims to discuss the reasons why urban studies (and respectively, urban design) cannot ignore *relations* and *time* effects between the studied elements (specified by the focus of the study) in any attempt which involves addressing urban space. More particularly, from the specific viewpoint of this study the relations to be considered are those between built form, street network and socio-economic function, as well as those between different scales, namely between parts and whole. The challenge for design is that on any occasion, in one way or another the product of design will have to address the issue of *change* either by building within or at the edge of an existing, yet constantly changing, system of urban patterns; or by creating new patterns from scratch. Either way, a design proposal will have to account for and expect change. Consequently, the challenge for research is to understand the origins and effects of spatial and physical change, so as to inform design. In Kropf's words (2001, p.29) a potential gap is identified with regards to conceptions on change in theory and practice: *'But while the fact of change may be acknowledged, studied or engaged in professionally, details of the process of change are not necessarily considered to be relevant.'* The thesis here aims to explore change in detail to show indeed that within the micromorphological diachronic urban processes can be found insights regarding the probabilistic performance and adaptability of the built form.

2.2.1.Insights from research

One of the implications that the study here aims to explore is the impact of the street network structure and its historical transformation on change in the built form. A pivotal stepping stone for this research inquiry has been the insights suggested in the study by Kayvan Karimi, *Continuity And Change In Old Cities,* (1998; see also in 1999; 2002) which explored patterns of continuity and change in Iranian and English historical cities. The study provides guidance and insights into the processes of urban change by addressing many aspects which are of relevance to the topic discussed in this thesis: firstly, the aspect of time – the study stretches back in time comparing the structure of the old cities before and after modernisation. Secondly, the study explores the interplay of the urban grid and the 'city elements' (old and new) over time – namely, it relates city building elements and their changes to the transformation processes of the street network. Effectively, this means that the study considers the parts-whole relationship, since it analyses the history of an urban district (the historical core) considered within and in relation to the growing and expanding wider city structure. Finally, presenting a cross-cultural comparison of contrasting case studies (in terms of the grid-elements relationship over time) the consistencies and differentiations observed contribute in validating the results and in indicating potential generic aspects of urban change patterns. Overall, the study suggests that the larger the scale of transformation in the grid structure, the greater the impact on the historical elements of the cities.

Karimi's research presents a case where the effects of grid transformation are examined in the case of an urban area which grows with and within the city, more precisely at the historical core of the city. Another study of significance with regards to processes of urban change is the *Adaptable Suburbs* project which examines an opposite case: that of areas at the edge of the city which have come to face the challenge of becoming part of an expanding urban grid. The project applied historical research with the use of temporal analysis using space syntax, morphological and cartographic techniques in order to explore changes in the spatial network, built form and land uses. Bringing together insights from four case studies[10] of the research project (comprising of the study of twenty six London suburbs in total), Vaughan et al. (2013) discuss aspects of urban adaptability and change at the peri-urban areas of Greater London. The study suggests that the combination of the street structure that supports the mixing of uses on the one hand and of building affordances in adaptation on the other has allowed for the resilience of these places on the face of urban change which came along with London's peripheral growth.

Those studies suggest that in order to understand both relations between *components* (buildings, streets, uses) and relations of *parts and whole* (namely, of scales), it is important to follow them through time, as they evolve, become more complex and shape and re-shape the parts and the whole, drawing references from one to the other. This is a core idea which suggests a balance between holism and inductive thinking (Kropf, 2001, p.33). Holism implies thinking about the 'whole' acknowledging a structural interconnection between parts and the whole, such that the parts cannot be conceived independently of the whole. In turn, holism also implies that the whole is not simply considered as the agglomeration of parts.

[10] The *Adaptable Suburbs* project (http://www.ucl.ac.uk/adaptablesuburbs) was preceded by another project on London suburbs; *Towards Successful Suburban Town Centres* focused on twenty-six case studies from the Greater London area; (http://www.sstc.ucl.ac.uk/sstc_index.html)

Clearly the term ‘evolution’ itself suggests notions of persistence through time and thus, implications of a historical study. Griffiths et al. (2010) argue that temporal analysis allows an understanding of historical processes of continuity and change. By following over time and understanding the patterns of continuity and change, a comprehension can be gained of where these evolving processes overlap and the ways in which the needs of the *physical* and the *social* city impact on one another over time.

2.2.2. The field of probability in city building

In Kropf’s reflections on the concept of change lies the final and forward thinking underpinning tenet of this research: that of ‘aggregates and emergent patterns’. It is worth quoting the author’s words as they reflect and phrase in the most faithful way the multi-scalar and multi-level trajectories of the *field of probability* in urban space and design:

> *‘One might then begin to pose such questions as what patterns, if any, at higher levels of scale are emergent from the mass of choices made at lower levels – and so outside direct, conscious human control? Do interactions at one level of scale (individual) lead to recognizable but not consciously planned patterns at higher levels (aggregate)? Are there instances in which an emergent pattern comes to be perceived and becomes the basis for conscious designs […]? What are the conditions and context, the range of possible choices, that allow the patterns – which are, in effect, objects – to emerge? Are there changes in the range of patterns (number and kind) that emerge under different conditions?’* (Kropf, 2001, p.39).

Stemming from this quote, the thesis here raises a fundamental question: have we yet fully explored the extent to which *‘space is a probabilistic machine’* as Hillier suggested (1996)? Or in other words, can space work probabilistically both in terms of *configuration* and *morphology*? It is with this quote and questions that this chapter leaves the reader to bear in mind as a background to the explorations which follow.

The next chapter describes the modest origins of the visionary ideas that shaped London and New York, two metropolises which advocate the powerful multiplier effects and probabilities emerging in urban space.

3

Chapter three - A metropolitan affair – making the ordinary extraordinary

3.1. Case studies: Selection parameters

This research investigates the historical continuity and change of the urban street interface considered as the product of built form and street network properties. The research topic conjectures a number of preliminary requisites regarding the case studies' selection. *From a practical and analytical perspective*, first and foremost, historical research necessitates cases of long-standing urban complexes whose development can be studied comparatively over time. Secondly, in order to address city-wide effects of urban growth, the built environments to be studied should be situated in urban grids that have already reached urbanisation. A third determinant was the availability of detailed historical data.

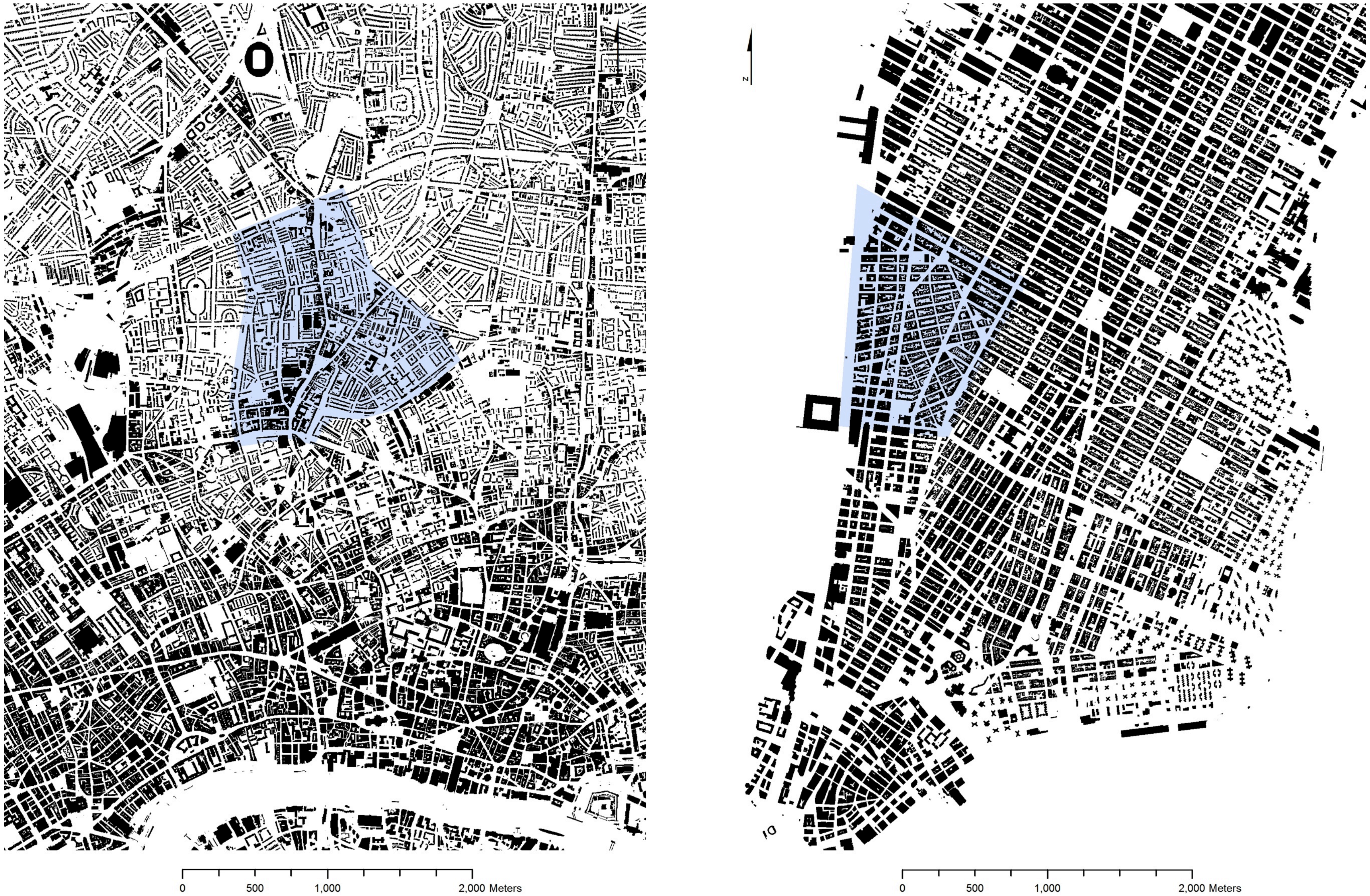
Both London and New York are cities which comply with these criteria. Although these metropolises have followed different evolutionary pathways in terms of their built form due to their varying geographical constraints and the effects of planning regulations, London and New York present a rather intriguing pair of case studies. Dennis argues on *Cities in Modernity* (2008) that these cities show more similarities than differences in their metropolitan development and that they have been exchanging influences over time (p.320, 349; see also Burdett and Sudjic, 2008, p.80). Beyond the two cities' historicity, the fact that there exists an extensive archive of each city's social, economic and spatial history provides an important advantage for applying historical research within their realms.

However, there is more to the reasoning for focusing on these two cities. *From a morphological perspective*, there were a number of factors to be considered as well. This research emphasises built form morphological properties which relate to the sociability of the street interface, through the study of the micromorphology of the virtual community. As mentioned in the theoretical background overview (Section 2.1.4), the work of Julienne Hanson has addressed street liveability from a morphological standpoint (Hanson, 2000; Hanson and Zako, 2007; Zako and Hanson, 2009). In this context, Hanson's study on 'Urban transformations' argued that modernist morphologies failed to reproduce the street-oriented qualities of historical urban settlements. In an effort to examine the micromorphology of historical street interfaces, the case studies in this thesis were selected based on the properties of their historical built form. Considering the longevity of urban row housing as a cross-cultural phenomenon (Davis, 2006; 2009), it became logical to study the simplest historical urban setting: that of ordinary narrow houses arrayed one next to the other and with their fronts facing the street. The terraced and row house building types are obvious representatives of such settings (Figure 1).

At the same time, in order to examine the role of the street network on built form change it became reasonable to look for urban complexes with a similar historical building context, yet with a different street grid structure. On the one hand, the London *'terraced-house'* and the Manhattan *'row-house'* present similarities regarding the scale of built volume, façade width and rhythm of plot organisation. On the other hand, the London and Manhattan grids present differences in terms of their emergence, structure and growth. Figure 2 shows the footprints of the two metropolises.

Figure 1. The narrow fronted urban house.

Showing a London terraced house (top) and a Manhattan row house (below).



Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

Figure 2. Figure-ground maps: the two urban grids.

Showing building footprints around Islington, London (left) and West Village, Manhattan (right). The case study areas are marked in light blue colour. (Scale 1:30,000)

Here, it is important to refer to the description of Hillier et al. (2012) regarding the spatial structure of London and Manhattan. Looking at the inherent spatial logic of cities, Hillier et al. explain that London and Manhattan both present *economically* driven urban structures overall, but that the spatial geometry in each case has generated different foreground-background network relations (*ibid.*, p.187-188). London's irregular spatial system belies a hidden geometry which arises at the level of relations between lines, and its growth follows the linear structure of the foreground street network (*ibid.*, p.187). The residential background elements of the grid, which support the urban micro-economic activity, are both spatially and functionally distinguished from this strong macro-economic foreground network[11]. In contrast, for Manhattan the 'top-down'[12] spatial geometry configures a grid where economic opportunity is equally distributed (often referred to as 'democratic'; see Ballon, 2012, p.13). The spatial outcome is a strong background network which does not differentiate itself considerably from the relatively weak foreground network (*ibid.*, p.188; see also p.171).

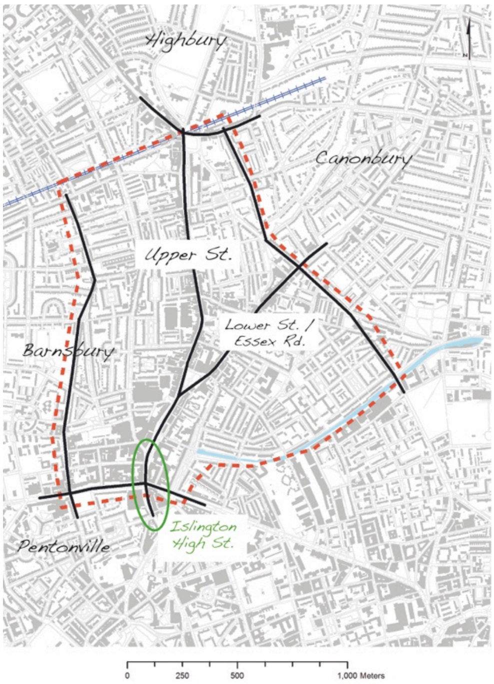
This structural difference in terms of the two cities' street network organisation prompts a clear line of inquiry by which to examine whether the historical built form transformation processes are in line with the grid properties in each case. To clarify, here the investigation does not aim to focus on the distinction between London and Manhattan – or respectively, 'irregular' and 'regular', 'organic' and 'planned' urban systems, 'top-down' and 'bottom-up' design approaches – but rather to explore the ways urban components can work together (or grow apart) over time in order to create generative places in terms of probabilistic encounters and co-presence in varying built environments. In other words, the study here emphasises configurational properties, rather than geometrical. In turn, via the study of these two contrasting grid configurations, it becomes of interest to examine the performativity of historical row housing schemes in each case, whilst also consolidating the argument regarding the impact of the street network on built form.

[11] The case of London and its foreground-background relationship is also discussed in Hillier, 2009.

[12] 'Top-down', meaning the planned, orthogonal character of the city grid which did not emerge via a gradual accumulation of urban parts, but was provisioned all at once by design.

Finally, analysis here zooms in at the street segment scale to look at the syntax of built form aggregation rules and the street interface produced. Hence, whilst the macro-scale was considered, there was still the need to find a particular area within each city to perform analysis at the micro-scale level. Subsequently, *Islington* in London and the *West Village* in Manhattan are the two urban areas extensively discussed in the analytical chapters (Figure 3). Across both cases, the historical built form (terraces and row houses respectively) maintains its strong presence till the current day. In addition, both these urban areas have undergone periods of decline and later of reclamation deriving from urban conservation and gentrification processes. Islington and the West Village provide in turn rich setups filled with varying stories of built form transformations to be revealed.

After this brief listing of the reasoning behind the case study selection, the following sections aim to familiarise the reader with the historical built form origins of London and Manhattan, before moving on to explore each city's micromorphology. The scope is to not simply present the two urban settings, but to highlight their main features, whilst reflecting on the way architectural and urban morphology embody in each case the city's socio-cultural identity.



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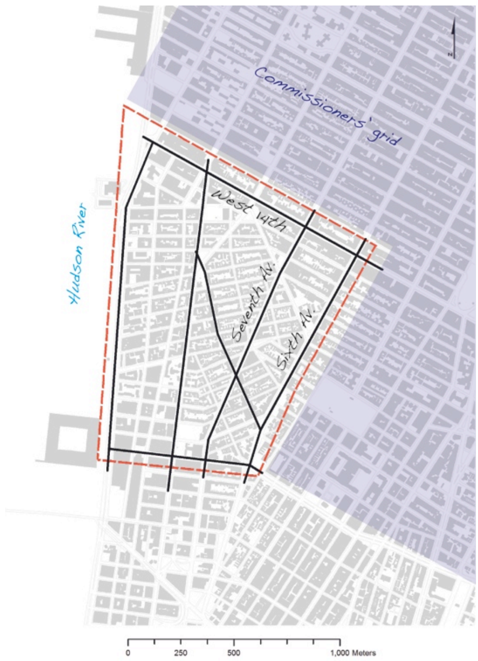

Background map: ©2011 Department of Information Technology and Telecommunications, NYC.

Figure 3. The two case studies.

Showing Islington, London (top) and the West Village, Manhattan (below).

3.2. Built form

This section goes through the main characteristics of London's 'terraced house' and Manhattan's 'row house' urban schemes. Firstly, each building type is introduced and its typical domestic space layout discussed in relation to family models and socio-cultural ideals. Furthermore, the reasons that granted the persistence of each type are mentioned. Moving outside the building interior and on to the block scale, the rules governing the aggregation of buildings in the terrace and the row are described. Finally, the building-street relation, being central to this research, closes this overview of the two building types and their historical socio-spatial context.

3.2.1. The London terraced house

The standardisation of the architecture of the English terraced house evolved in London more than any other English city (Guillery, 2004). In the late eighteenth century contracting firms had already started to replace the small wooden houses of traders, artisans and working-class settlers with back-to-back terraces (*ibid.*). In their more spacious versions for the well-off, the London terraced house is said to have been formed in order to embody the British ideals of 'dwelling' (Summerson, 1945).

One of the foremost requirements within British culture has been the separation of residence and work (at least, post industrialisation, from the 18th century onwards). As Hollis discusses in her research on 'workhomes' (2007; 2011) this separation has not always been the case; rather this was a fundamental shift in industrial societies (Davidoff and Hall, 1987; Dennis, 2008). This 'live away from work' concept was complemented by a preference for a family-owned residence, and by societal segregation along class lines. Beyond practical claims, the terraced house served as a building unit used for 'the reinforcement of cultural identity' (Davis, 2006, p.90). As will be discussed, the symbolic use of architecture is a main feature of London's nineteenth century urban built form – even for these ordinary buildings.

The plan

In Georgian and Victorian terraced houses (18th and 19th centuries), characteristics such as size, comfort, separation of functions and users' privacy, and later, sanitary provision were dependent on the inhabitants' socio-economic status (Summerson, 1945; Guillery, 2004). The basic terraced house unit is two-storeys high with two main rooms per floor: the front and the back room. Bigger units may present additional floors, a basement or a back extension. Higher buildings indicate more rooms, and respectively, a more prosperous family. In these larger configurations, the basement usually acted as the servants' dwellings. These units could also increase in depth; however, the width of the narrow building frontage remained fixed, especially in the case of London terraces (Muthesius, 1982, p.86).

Figure 4 shows 'the four classes of London houses' taken from Muthesius (*ibid.*, p.81; after Simon, 1875). Muthesius explains that this categorisation broadly classifies the many terraced house size variations that appeared in Georgian and Victorian London, starting from a twelve main room configuration at the maximum, to a small terraced house of four or five main rooms (*ibid.*, p.86). Table 1 summarises the different functions according to the capacity of the domestic space. In a small working-class dwelling, the kitchen and dinning room make up the basement space, the elevated ground level houses the front and back parlours, and finally the upper level holds the family's private bedrooms (c.f. Guillery, 2004; Daunton, 1983). Larger units keep ancillary spaces in the basement as well, along with the servants' quarters. The elevated ground floor and first floor hold the reception rooms, study rooms, a boudoir and/or a library. The upper levels of the house are again devoted to bedrooms.

Activities in the traditional terraced house followed a *strong spatial programming*. Functions are assigned to specific spaces. Room labelling reflects the common cultural notions of the eras which prescribed a distinction between the family's everyday living quarters and the formal 'front' of the house. In larger houses the drawing room was considered the best room of the house and so became the most prominent 'reception room', whilst in smaller dwellings visitors were received at 'the parlour', namely the front room at the ground level. The main characteristic of the traditional terraced house configuration refers to the organisation of domestic functions around the circulation core of the house, the corridor, or 'hall' (Evans, 1978; Muthesius, 1982; Hanson, 1998). Separate rooms connect to the corridor, but not to other rooms. The staircase would be placed either at the end of the long corridor line, or adjacent to it and in the middle of the floor plan, dividing the front and back rooms. Hanson and Hillier (1998) explain that this layout forms a *'transition integrated' complex*, where emphasis is placed on the separation of functions. Indeed, privacy was a desirable feature within a domestic space and was enhanced by the way terraces were designed.

TABLE 1 Terraced houses						
Rooms	16-20	10	8	7	6	5-6
Living Rooms	5-6	4	3-4	3	-	-
Drawing room (parlour)	x	x	x	x	x	x
Dining room	x	x	x	x	x	x
Breakfast	x	x	x	x	x	-
Study	x	x	Works as an extra bedroom	-	-	-
Bodoir/Library	x	-	-	-	-	-

Table 1. Terraced house sizes; room capacity and room functions.

Figure 4. The four classes of London houses: ground floor plans.

The plans are redrawn after Muthesius (1982, p.81).

Terraced houses with 3 floors (including the ground floor), no basement.

Terraced houses with basement and 3 floors.

Terraced houses with basement and 4 floors.

Figure 5. Terraced houses of different sizes.

The persistence of the type

English cultural ideals for domestic space remain for many centuries in the terraced house. There are multiple reasons that allowed for this building type to persist, not only time-wise, but also in terms of the diverse social needs it was called on to fulfil: besides enduring over time and the processes of urbanisation, throughout its many variations the terraced house has been occupied by all social classes of English society. Even in the case of London, where urbanity continuously demands greater densities, the terraced house maintains its role as one of the most popular dwelling types, and still caters for diverse audiences.

Muthesius lists several contributing factors for the persistence of the terraced house (1982, p.145): cultural concepts related to the ideals of 'dwelling'; the tendency for class separation; the preference for terraced houses over other housing alternatives (such as blocks of flats); the compactness and flexibility of the plan; and owner occupancy on the one hand, with the potential for multiple occupancy on the other. As mentioned in the thesis's introduction, Davis explains how varying aspects of the building culture in terrace housing both encouraged its wide application, and at the same time ensured its own constant redefinition and modernisation (Davis, 2006).

London's continuous growth meant the expansion of its centre towards former suburban areas. Once introduced, this urban buzz (namely, the multiple and diverse probabilistic encounters and co-presence at the street domain of cities; Hillier, 1996), and subsequent pressures for higher densities in these 'quieter' places, strongly threatened the small terraced house. Both London and New York, however, developed during the post-war years a sensitivity regarding the protection of their urban past. In London conservation policies and legislation protect the future of historical terraces and constitute nowadays perhaps the most fundamental factor in the survival of this building type. The conservation model devised to preserve London's terrace housing is particularly interesting, due to its aim to protect not only the architecture of the built form, but also what it provides in terms of the quality of urban life. Looking at the case of Islington (in Chapter 5) will provide an understanding of the impact of these conservation policies on the built form and on local life.

Finally, this study suggests another important parameter which affects persistence and change in the built form: the city grid itself. In Chapter 5 (Part B), where the built form stories of Islington terraced houses are examined in detail, the study discusses the role of the street network in the survival of the historical building context in urban settings. This inquiry is further expanded through the research of Manhattan's urban past, in Chapter 6 (Part B).

Rules of aggregation

This study stems from an effort to consider building typologies from an urban-scale perspective; that is, to discuss the performance of common urban buildings as components of the city realm. A pivotal factor in electing to focus on the London terraced house, and its equivalent in Manhattan, is the fact that their characteristics are adherent to all architectural scales: the building, the block and the street. These buildings were conceived with a synchronic consideration of their role both as individual units, as well as parts of the row and of the street domain as a whole. The row house is at once a distinct, private dwelling on the one hand, and part of an extended, continuous block, with its front to the public realm, on the other. After visiting the building interior, the following paragraphs discuss the integration of the house unit within the row and its surroundings.

The London terrace is arguably the strongest affirmation of morphological and architectural unity observed in the building volume of ordinary urban settlements. The term 'terrace' refers to a row of terraced houses. Muthesius argues that *'no other country took regularity in its ordinary houses to the same degree as the English'* (1982, p.14). The grand London terrace came to being from the English desire to apply the classical palatial style to the architecture of everyday domestic buildings (Figure 6). The first grandiose Georgian terraces inherited a classical morphological order: the organisation of the façade followed the architectural principle of emphasising the centre and the two ends of the row (Summerson, 1945; Muthesius, 1982), whilst also maintaining reference to the buildings' crown-body-base horizontal zoning. The terrace façade was treated as a unified architectural object, with the materials of its skin (brick or stone) laid continuously across the whole surface. In contrast to other row housing schemes, the visual separation of the individual narrow housing units with emphasis on vertical elements was often muted here. It could be said that we refer to a sewing together of building units, rather to their simple aggregation. A recent study of Bloomsbury squares describes extensively the ways the aesthetic treatment of the façade with decorative elements on the horizontal is frequently designed as a uniform whole (Nousa, 2014; see also Ashton, 2012, p.132).

Figure 6. Islington, London – the grand London terrace.

Figure 7. Victorian terrace.

Of all the rules of aggregation applied to the London terrace, the most powerful and persistent refers to the absolute compliance of each terraced house with the building line. Speculative building – which meant effectively that those buildings of the same row were built up together, at the same time – was one of the main factors that allowed this tenet to persist. The principle is maintained not just in Georgian style terraces, which advocated the simplicity of the terrace façade via a plain continuous surface, but also in the many volumetric variations and projections (for instance, the bay windows) of the more playful Victorian fronts (Figure 7). The plain surfaces on the one hand, or the projections and setbacks on the other, are all lined up in absolute order. The building line is also maintained in the case of smaller terraced houses, such as those inhabited by the working classes, where modesty and simplicity predominate.

This organisation of the façade is not dependant solely on architectural and aesthetic parameters. Materials and their specifications[13], building structure and construction techniques[14], building regulations[15], as well as interior organisation, are additional factors which impact on the architectural treatment of the building front. However, within the scope of this research, the aim is to examine the micromorphology of the sidewalk in terms of the building-street (interior-exterior, private-public) relations. This in effect implies an analysis of the order and density of building thresholds by the building morphology. For instance, it is of interest to point here to an observed shift in the rules of aggregation which appeared as a consequence of the back extension added in terraced houses. In a typical early terrace format, doors are separated by windows on both their sides. After 1850, the front doors of two neighbouring houses became adjacent. The door-window sequence now turned into window, door, door, window, etc. This was an outcome of the back yard reorganisation: two adjacent houses now had respectively joint back extensions. The floor plan organisation dictated that the building entrance be in line with the back extension; hence the houses' front doors also became adjacent, creating different dynamics in terms of interior-exterior encounters.

[13] Davis, 2006, p.166, 170.
[14] Davis, *ibid.*, p.166-176.
[15] Muthesius, 1982, p.33-37; Davis, *ibid.*, p.201-202 and p.214-217.

Finally, rules of aggregation that extend beyond the row itself, also affect the terrace morphology. These refer to the street layout and define both *symbolic* as well as *practical* parameters regarding the way the built environment is set up. From a symbolic point of view, the power of the London 'estate' and of classical and neo-classical planning principles needs to be considered. The estate is an area speculatively built by developers (see Davis, 2006, p.55 for a synopsis of speculative building practice in London). Strong geometrical forms, i.e. squares, rectangles, crescents, and long straight lines, are applied to both the morphology of the street and the buildings' form. The desire for green spaces in the urban and suburban landscape is another element that has contributed to the design of many such classical squares in London.

The paradox in this case is that the 'symbolic use of space' – as Hillier puts it (1989, p.12) – is extended to the residential parts of the grid, instead of being solely the architectural privilege of the city's administrative and economic foreground. The result is that the aggregation rules for housing units conform to austere urban design principles, without allowing for unplanned emergence: consider, for instance, the quadrant rows around crescents and their neo-classical symbolic geometry (Figure 8). However, due to the endless number of those Regency estates and their introverted, distinct spatial profile, the overall city configuration appears random in terms of its street geometry. In a sense, while the intention for symbolic architectural grandeur is global, i.e., it applies to the whole city, the method of application occurs at the local level – in a way that London eventually grew *'more by fortune than design'* as Hebbert puts it (1998). To Hebbert, London has allowed for heterogeneity which encouraged in turn diverse localities. Indeed, London estates varied in landscape design, size and area covered, including many terraces or even just one. Subsequently, the London terrace is connected by design and morphology to its immediate surroundings, but at the same time it stands as an autonomous urban unit. This fact is also emphasised by the terrace's social unity. It was customary that residents of the same social class occupied terraced houses along a block front (c.f. Chapman, 1955; Bourdieu, 1979; McKibbin, 1998; Gunn, 2004). Overall, the rules of aggregation highlight the unity of the row as an urban object, with the individual terraced houses being the sub-components.

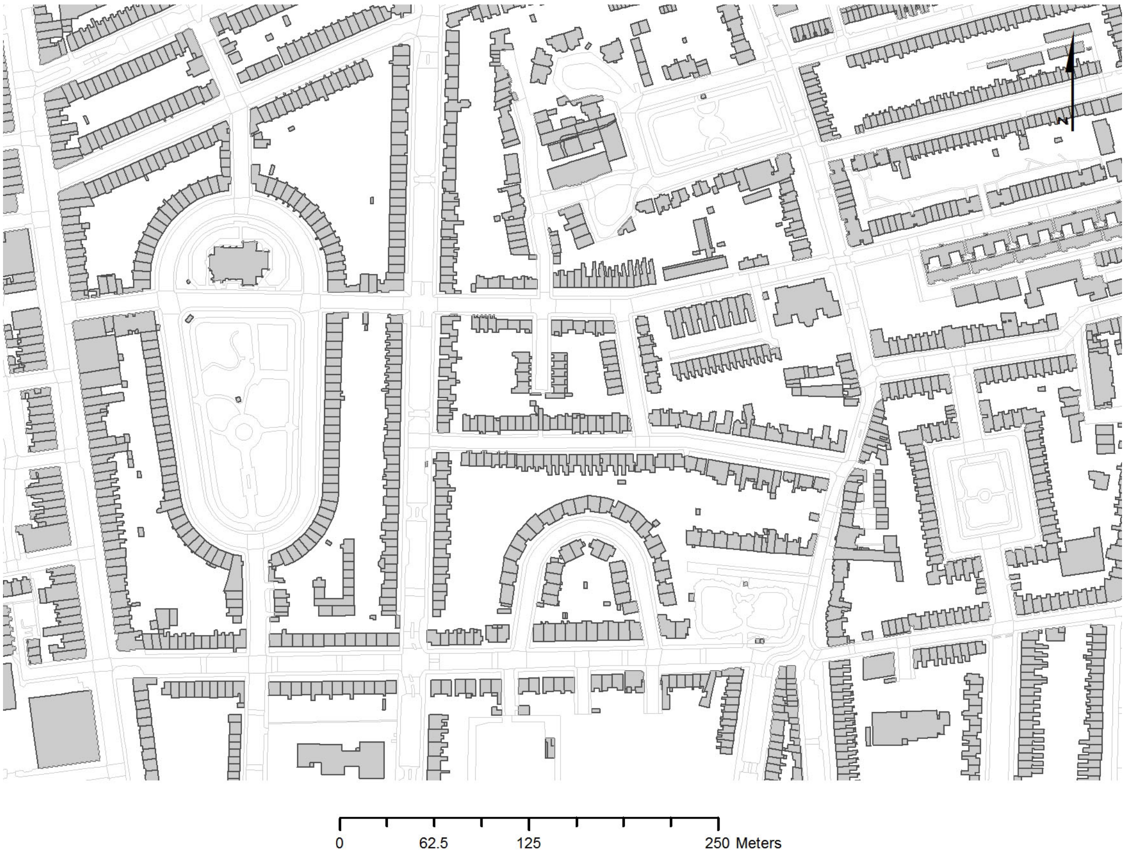

Figure 8. The London terrace: figure-ground map; crescents and squares.

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

Besides the symbolic design parameters which shaped the urban terrace, there are also practical ones. Matters of sanitation, light and fresh air, drainage, heating etc. have themselves an impact on the terrace built form (see Muthesius, 1982, p.49-62). These factors influenced the width of streets and the height of buildings – and respectively, their ratio – as well as elements of the façade (such as the type and size of windows and their casements, chimneys etc.). Exploring morphological possibilities, Philip Steadman (2014) classifies built forms mapping them across a two-dimensional 'morphospace'. Steadman considers the rules of built form aggregation with regards to geometrical properties of the building plans alongside the potential arrangement of building units with respect to daylight (see also earlier in Steadman, 2003). Finally, amongst the practical parameters, standardisation of construction and technological advancements also left their mark on the building outcome (Davis, 2006, p.57).

Relation to the street

Built on its own piece of land, with its front facing the street, the narrow terraced house achieves a strong relation with its neighbouring realm. The degree up to which the house opens up towards the public domain depends on a number of factors: the size of the terraced house, its period of construction and architectural style, as well as the social class of its inhabitants. Moreover, as Hanson points out (1998, p.115-117, 123-125), the relation to the street can be achieved in terms of *permeability*, of *visibility*, or of both. However, the most important feature refers to the high potentials offered by the terraced house morphology to support a frequent pattern of potential interior-exterior encounters on the one hand, and of a lively street domain on the other.

Figure 9. Terraced house – building-street relation: the area.

The major difference in regards to this building-street relation rides upon the presence or absence of a basement. Where a basement exists – as is the norm for larger units, and in London in particular a basement is also very frequent in smaller ones as well – the need for a window to provide a hint of daylight and fresh air creates a complex micromorphology for the terraced house front. A space is left open in front of the basement, at the lower ground level, which is about one-and-a-half to three meters wide: the ‘area’ (Figure 9). The main entrance of the house is accessed via a small flight of stairs and in larger units via a bridge. Underneath this passage, a separate entrance for the basement is placed. This is accessed via a descending narrow staircase fitted within the ‘area’. Where permissible by the area’s width, there may also be some integrated storage space. In order to protect the sidewalk users from the change in height, a cast-iron railing bounds the ‘area’ gap. In many instances, the cast ironwork includes a low-height secondary door between the street and the main domestic entrance.

As Davis observes, in many building cultures around the world, an ordinary building type can *‘change over function and economic class’* (2006, p.135). The author discusses the example of courtyard buildings in Cairo and Tunis. In the case of the terraced house, when considering the building-street relation, architecture comes hand-in-hand with the social status of inhabitants. The first factor to consider in this respect is size. The size of the terraced house has many implications affecting both the entrance’s architectural treatment and the openness of the house to the street domain. As described already, the presence of a basement is one example. Another instance is the building height (see Figure 5 earlier). Since the building front is fixed in its width, larger units increase significantly in height, up to the point that the width/height ratio is on the verge of that considered aesthetically disproportional (Muthesius, 1982, p.170). In order to visually smoothen the narrowness of the façade, horizontal elements were introduced; the entrance portico and pilasters were emphasised in the case of latter houses, and along with the elevated ground floor they add up to the architectural demarcation of the domestic and public domains. Besides the obvious and tangible impact of building size on the treatment of the entrance, there is also the implicit distancing of the house’s ‘public face’ from the street level; firstly with the elevated ground level, and secondly with the placing of the visitors’ ‘reception room’ on the first floor (namely, the drawing room which is only found in the larger terraced houses). In contrast, the working-class terraced house – more modest in height and decoration, and often without a basement – exhibits the ‘public face’ of the house at street level. In general, the smaller the house, the more direct is the relation to the street.

Overall, the terraced house has an inherent potential for a strong relation with the street: there is the potential for interior-exterior intervisibility at the ground level, and also the domestic entrance lies in close proximity to the sidewalk. In a way, if desired, maximum building-street interaction can be achieved, both in terms of visibility and permeability. Further elements – such as the degree to which the interior function is displayed to sidewalk users, or the extent to which the entrance configuration is used as a strong or loose demarcation between the private and the public domains – depend on the appropriation of the terraced house by its inhabitants and the cultural models that they endorse and reproduce through space (Hanson, 1998). An examination of the way social class and cultural ideas (and ideals) affect the dwelling's performance is presented in Hanson's *Decoding Homes and Houses,* Chapter Four, 'Two domestic "space codes" compared' (1998, p.109-133). The study looks at the properties of the elementary small terraced house when this is occupied by the traditional working-class family, and when it later becomes 'reinvented' by the middle-class. All these properties and possibilities become intensified in the context of the terrace, via the repetition and order of the overall morphology.

In the housing culture of London, both the terraced house (building scale) and the terrace (block scale) follow spatial and architectural formalities. The terrace bears such morphological and social unity, that it could be considered as a single building taking up the whole block front. At the same time, terraces hold a strong connection to the street due to the high frequency of entrances and door-to-door encounters. Architectural style and the construction process may have changed over time, but standardisation has always been part of the terraced house building practice.

3.2.2. The Manhattan row house

The New York row house is the typological counterpart of the London terraced house. The American version was largely informed and influenced by the English urban building (Davis, 2006, p.151). However, cultural differences have forced the type into its own evolutionary course. It becomes therefore of great interest to see the way a building typology can grow differently depending on the wider socio-spatial urban context.

The city of New York in the eighteenth century covered only the lower part of Manhattan where work, trade and residence existed in close proximity to each other. In those early development years building units did not separate work from domestic use. Row houses appear rather as mixed-use units, fostering both residence and workspace. The unforeseen economic and population growth that marked the turn of nineteenth century brought along Manhattan's radical building boom (Lockwood, 1972, p.2-6). The increasing dominance of commercial usage in downtown Manhattan, and the high influx of immigrants, created an imperative demand for new housing development. As in the case of London, the party-wall row house became the most popular building pattern, offering as it did maximum land exploitation. It was at this time that *single-family row houses* started to spread northwards, forming the city's oldest neighbourhoods of Tribeca, Soho, Greenwich Village and the East Village. It was not long, however, before commerce followed the northward expansion as well, gradually invading each of those areas. (Dolkart, 2009, p.9-10) Over time, commerce came back into the row house unit, demonstrating once again the flexibility of the type.

The plan

Early row houses were built upon the architectural guidelines of the Federal Style. The Federal Style appeared in the period of the 1820-30s building boom and derived from the English Georgian style. The typical Federal house plan was already established by the first decades of the nineteenth century and lasted until around the 1890s. Later appropriations of the type were all based on this basic plan layout. Similar to the London terraced house tradition, size variations according to social class appear in the Manhattan row house type as well.

Figure 10 illustrates the typical configuration of the Federal house layout for smaller and larger units. In general, the floor plan organisation is almost identical to that of the terraced house. The house is accessed via a flight of steps, called the 'stoop'. The name *stoop* has Dutch origins (*stoep*). In the Dutch building culture the stoop is the small flight of steps to meet the building entrance and is found regularly in Dutch row houses as it served to protect the interior from the floods (Lockwood, 1972, p.10). Entering the row house, one finds the small vestibule before reaching the main circulation zone of the interior: the hall and the staircase, which links all floors. Light and ventilation requirements caused by the adjacency of other buildings allowed for only two main rooms per floor, with windows at the front and back of the house. Each floor serves a different group of the family's everyday living activities. The basement contains the informal part of the house, where the kitchen and dining room are found, with the latter facing the street. On the elevated ground floor, there are the front and back parlours, providing the house's formal reception. Lastly, on the upper floor(s) are the family's private bedrooms.

Figure 10. The row house: floor plans.

Redrawn from Lockwood (1972, p.14-19) and Dolkart (2009, p.31).

Whilst the functional organisation of the row house's interior follows the principles of the terraced house, the *configuration* – namely, the way spaces relate to each other and to the whole building – presents a significant difference. As discussed in the previous section, in a typical terraced house, rooms link to the corridor but not to each other. In such a configuration, privacy, and the functional separation of the domestic space, is firmly established with the use of fixed partitions (walls) and the existence of only one entrance/exit for each room. Looking at the justified graph representation, the configuration is interpreted in terms of circulation (Figure 11). The terraced house's justified graph shows clearly how spaces represent mainly destinations, and hence, they are used for programmed occupancy. In contrast, in the early Manhattan single-family dwelling a different relation amongst spaces is observed: permeability through spaces is allowed and rooms show the potential to serve both occupancy and circulation (notice the circulation rings, marked in red in the graph in Figure 11). The whole layout is linked together, with two (or even more) entrances per room: one door leads to the main corridor, and the other(s) to another main room of the house. Privacy becomes less tangible and functions are not so strongly related to specific users (even in the case of bedrooms, despite being naturally the most private rooms).

As Hanson and Hillier explain (in Hanson, 1998, p.130), this spatial configuration increases the chances that a space is more frequently used. To use the authors' term, it can be said that a row house is more of a 'space-integrated complex' (spatial significance appointed on rooms), rather than a 'transition-integrated' one (spatial significance appointed on circulation), as in the case of the terraced house. Overall, while relevant activities still remain clustered at different levels, the lives of a New York row house family would appear less programmed by their housing space than a family dwelling in the English model.

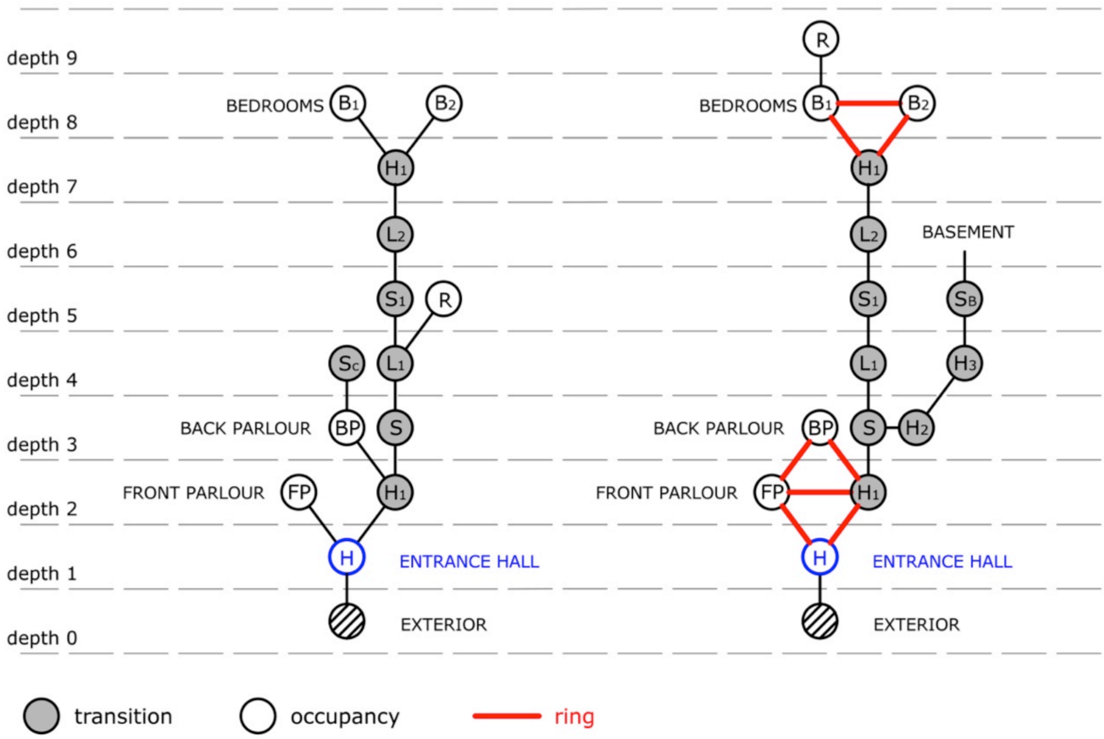

Figure 11. Terraced house and row house: justified graph representations.

Showing j-graphs for the ground and first floors of a terraced house (left) and a row house (right). Each room is represented as a circle in the graph, while the connections between rooms are marked as lines linking the circles/rooms. The graph starts from the building exterior and 'moves' towards the building interior.

The persistence of the type

Since its early shaping, urbanisation in Manhattan placed an extensive pressure on the survival of the historical built form. Davis notes that *'[b]y the 1890s, many neighbourhoods of Manhattan had already undergone at least one circle of building replacement and increasing density'* (2006, p.59). Lockwood (1972) characteristically quotes the words of Philip Hone in 1893 (p.6): *'The whole of New York is rebuilt about once in ten years*'. For the borough of Manhattan in New York, urban expansion was not an option. In order to house higher densities, the city began to extrude in height. The major threats to row houses came firstly from the tenements and later from high-rise apartments. Tenements were built in response to the high demand for working-class housing, while high-rise apartments came to introduce higher densities and collective urban living to the middle and upper classes.

However, there was – and still is – a part of the urban audience that showed preference for the urban row house. Those in favour of these small historical buildings came from different socio-economic backgrounds and thus their motives relate to various aspects offered by the row house lifestyle (Dolkart, 2009). Single-family occupancy has undeniably been one of the reasons for the persistence of the type. The fact that many of these row houses were owner occupied by successive family generations also contributed to their survival, as did the historical row houses' presence in city areas close to Lower Manhattan's urban buzz and economic centre. Other factors include the cheaper rents associated with row houses (in comparison to mansions or fashionable apartments), allowing artists to occupy these units and initiate their revival; lifestyle trends which attracted young professionals; and the lure of profit for the building market which brought the row house to the attention of developers and gentrification projects.

Another factor that has prevented the decline and demolition of these historical small buildings is the designation of row house regions as 'Historic Districts', the equivalent of London's 'conservation areas'. These designations were triggered by the activism of theorist Jane Jacobs against re-development projects which shredded the city's historical fabric. The West Village in Manhattan, a case study in this thesis, was Jacobs's neighbourhood and her acting ground. In the relevant analytical chapter (Chapter 6), the role and provisions of the Historic Districts are extensively discussed.

Rules of aggregation

Although the Manhattan row house is a typological derivative of the London terraced house, there are many differences observed between the two types when considering the block scale and the urban setting as a whole. This section describes the rules of aggregation for the Manhattan row. It appears that these rules are in line with the profile of the dwelling: they allow for probabilities to occur.

In Manhattan, uniformity in the row housing block front is not a given fact as it is in London; rather, this property is dependent on architectural style (which relates to the date of construction), social class and speculation. Architectural style relates to social class and to lifestyle preferences. In general, the working classes and the artists' urban bohemia voted for individuality and picturesque qualities. Speculators upgraded these qualities and the middle classes and young professionals soon followed the stylistic trends of the 're-born' row houses (Dolkart, 2009). The upper classes looked for imposing façades in decoration and scale, and thus showed preference to more unified block fronts. The rules of aggregation range from flexible (Federal style) to more austere (Greek Revival and the many grandiose 'revival' styles that followed during the brownstone era).

As discussed, in London the terrace is conceived and built at once as an entity made up from terraced houses. All terraced houses within a row present the same, fixed basic morphological characteristics; namely, their width and height are equal – with the exception being some Classical palatial terraces which highlighted the central and corner houses of the terrace. The architectural composition was applied to the whole terrace treated as one building façade. This is not the case for the early Manhattan block front, where row housing displays less formality[16]. In the city's first steps towards higher densities, houses were not always built upon speculation, and speculative building itself was not necessarily applied in the whole block front. Builders started gradually with the construction of three or four houses together, later expanding the practice to construct simultaneously whole block fronts and even wider areas of the city. Subsequently, in the early Federal rows, the width of the houses varies depending on the plot size[17]. Building height is not fixed either, resulting often

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[16] Lockwood notes: *'New York row houses usually were slow to reflect national architectural ideals'* (1972, p.32).

[17] Early row houses were usually built on 25-feet-wide lots, a width size that decreased gradually over time to 20-feet, 18-feet, 14-feet and even 12½-feet-wide lots (*ibid.*, p. 143). The established building depth of the time was thirty-five to forty feet.

in an irregular skyline. Adjacent houses could present a slight difference in height, indicating that informality and individuality within the row complex were accepted architectural features at the time.

However, after the 1830s when the Greek Revival movement brought architectural grandeur to ordinary houses, the rows in Manhattan started to present uniformity across their whole length. Speculative builders were taking up larger and more prestigious projects to address the housing demands of the middle and upper classes. As in London, a whole row would be designed and erected under uniform architectural and structural guidelines, and a consistency in façade width and height would be maintained. In these cases, houses were also similarly, if not identically, decorated with ornamentation. Still though, the overall architectural treatment of the row presents a fundamental difference to the London terrace. In the Manhattan version the vertical repetition of building units (namely of row houses) is amplified instead of being smoothened. The vertical rhythm becomes stronger with the highlighting of the building entrance; emblematic stoops, porticos and pilasters state clearly the presence of individual dwellings. Whereas terraced houses were carefully joined to resemble one building, row houses were discretely distinguished as units forming part of a whole. Figure 12 shows an example of such architectural detailing where the row's crown is slightly broken up right above the party-wall line. It could be said that the row is the aggregation of individual units with relevant building façade treatment.

This principle of maintaining individuality survives throughout the urban history of the row house. During the row-house revival movement of the twentieth century, the architecture of the row again enjoys the freedom observed in the Federal block fronts. Dolkart discusses the way artists contributed to the redesign of many row house facades, turning them into fashionable and desirable dwellings. In these houses, individuality is further emphasised with the use of different colours or materials on façades. These twentieth century row house renovations very often encroached on the building line as well. Stoops had become obsolete and many owners removed them to recompose a new house front which extended towards the plot line (see Figure 13). Such actions further broke up the block front's continuity. Again, uniformity in design depends on the speculation or rehabilitation purposes to match the needs of specific audiences; there are examples where the row is completely unified up to the point it looks more like a court building (see Figure 14).

Figure 12. The Manhattan row: rules of aggregation.

Figure 13. The Manhattan row house: façade alterations; stoop removal.

Figure 14. The Manhattan row house: renewal projects.

Showing five row houses at 18-26 East 8th Street combined into two apartment houses by the architect Julius Franke – completed in 1917. (For details regarding the project see Dolkart, 2009, p.139-140).

In all, the aggregation rules in Manhattan rows permit a considerably more playful scenery than the one we meet in the London terrace streetscape. In his account of ‘The building culture of New York in the 1890s’, Davis underlines: *‘Among the thousands of buildings built, architectural style was hardly consistent.’* (2006, p.65) Nonetheless, it is important to note that this playful setting does not lack in regularity or unity; rather, these properties appear here more implicit instead of being obvious as in terraces. This regularity in rows is the output of a morphological order – rather than an architectural or aesthetic order – and is based on a two-dimensional gridiron which organises the built volume. This gridiron is none other than the 1807-11 Commissioners' Plan.

In 1807-11 New York Commissioners programmed an underlying order based on an orthogonal template to guide Manhattan’s street development. Amongst the factors considered for laying down this grid were the geographical shape of the borough, issues of orientation (sunlight and air for the buildings), the historical trade routes linking the city to the harbour, as well as other historical arteries (such as the lines of Broadway and Sixth Avenues). In contrast to the London development plans, which were applied at a more local scale (see the discussion in the previous section regarding London estates), in Manhattan speculation and planning referred to the whole city. From the street gridiron subsequently derived the outline of the blocks and their subdivision into plots (Ballon, 2012, p.87). The plot pattern provisioned fixed dimensions (both in width and depth) which organised the block land – and respectively, the built volume – in a systematic way. It is therefore understood that regularity is the main characteristic across all scales of the gridiron, from the street configuration to the plot pattern.

These rules of regularity and the emphasis on repetition passed on to the building volume, both through the form of morphological principles which informed the design of row house façades, and through the resulting building practices. Professional builders and craftsmen followed a ‘routine’, a standard and well-understood ‘type’, with design and construction processes based on builders’ guides (Lockwood, 1972, p.30) which contributed to a systematic building method. In turn, these handbooks established the basic morphological principles for row house façades: the trilateral horizontal zoning which defines the alignment of windows, and consistency in the placement of the building entrance at the either side of the façade. These basic principles were generated by the plan layout. Later in this thesis (Chapter 6B), the consistency between the row house floor plan and its façade organisation is explained in greater detail. The main point to understand here is that the row is visibly an accumulation of single houses, whose façade nevertheless follows the same implicit morphological order. This order is not so much about controlling every architectural detail and composing a solid block front; rather, it works as an underlying grid, as a common organisational logic.

To summarise the key points, London's historical terraced housing presents a more uniform architecture, but the aggregation rules are applied at the local and building scales; the row housing of Manhattan shows a less uniform architecture, but the aggregation rules are applied across all scales. In the London version, the most dominant element is the *terrace*, with its architectural and social unity. In a sense, the design aim is for order to be apparent in the built volume and for urban districts to be distinguished. In Manhattan on the other hand, the *street* is the strongest urban component: the *grid* overrides any other organisational principle. This grid is not simply applied to the street layout; it runs across scales, holding the urban elements together. Order is implicit, organising the built volume, and the street gridiron aims to unify urban parts.

Relation to the street

The primary element that defines the building-street relation in the case of Manhattan row houses is the *stoop* (Figure 15). All row houses, regardless of architectural style, originally had a stoop. The stoop consists of few ascending steps which lead to the main domestic entrance. It is only after the early years of the twentieth century, when stoops became unfashionable and the city more urban, that the building entrance in altered row houses is regularly found at the ground level. Similarly to London's terraced houses, the stoop is the architectural aftermath of the ground floor elevation due to the need for a basement. Maximum land exploitation was a definitive requisite since the very early years of Manhattan's urbanisation. Including a basement with provision for natural air and ventilation – hence the ground floor elevation – meant that additional space could be provided to the family (Dolkart, 2009 p.16). The basement was then an active part of the house, used for informal daily family activities (dining at the front, cooking at the back). Again, as in the London version, the basement presents a separate entrance, accessed via the 'areaway' and a set of descending stairs.

Figure 15. The Manhattan row house: stoops and areaways.

The stoop creates an indirect building-street relation; it increases physical distance and decreases visibility potentials from the street to the domestic interior. The relation between architecture and social class is once again confirmed. Higher stoops – and thus greater distance between the private and public domains – refer to higher social class. Effectively, the whole configuration of the 'areaway' – the equivalent of the outside 'area' in the London terraced house – increases in size. The varying ways the building-street transition is structured according to architectural style for the row house typology is overviewed later in this thesis (Chapter 6B). At this point, it is of interest to note that the stoop was not solely a transition space; it was commonly appropriated also for occupancy and informal socialising. The stoop extended the interior activities to the sidewalk (and vice versa), it increased chances for social interaction, and thus added to the liveliness of the house front, and therefore to the vibrancy of the street overall (Ballon, 2012, p.205).

Over time the building-street interface across a row became more diverse. The flexibility enabled by the aggregation rules incorporated numerous changes in the buildings' façades, such as the replacement of stoops with direct entrances, the addition of another entrance, or the opening of a commercial window display. All these changes brought together a complex and vibrant micromorphology at the sidewalk level. The image of playful scenery mentioned earlier is further enhanced and extends from the morphological principles of the built volume to the configuration of the sidewalk.

In the Manhattan housing culture, both the row house (building scale) and the row (block scale) present a more flexible and user-oriented spatial and architectural configuration than that seen in London's terraces. The row is essentially the sum of building units organised along the same morphological principles. Within the row, architectural details may vary; the degree of variation (or unity) depends on style and architectural class. The most characteristic feature for the row in terms of the block front is the stoops. Stoops create a vibrant and sociable micromorphology at the sidewalk by adding a transition space between the public and private domains. Standardisation is part of the building practice but over time individual building solutions were embedded into the standard row house form.

3.3. Street network – the two grids

Our focus has so far moved from domestic space (building scale), to the principles, morphological and social, that shaped historical row housing complexes in London and Manhattan (block scale). In order to complement this brief exploration of the historical origins of each city, it is essential to go through some important points on the city scale – more particularly, on the urban street network. On first sight, it would be natural to assume that these two cities present converse grid morphology; very little order is visibly detected in the London grid, whereas a great deal of geometrical order underpins the Manhattan footprint. The final part of this chapter aims to reiterate for the reader some key features and ideas embedded in the London and Manhattan grids, by looking beyond first impressions.

3.3.1. London grid

Julienne Hanson's doctoral thesis (1989), *Order and Structure in Urban Space*, examines in great detail the morphological origins of the City of London. Hanson dissects Roman, Saxon, Medieval and Early Modern London to unravel the conjunction of morphological and historical processes in shaping the urban grid. Her work brings to light the significant changes and continuities throughout the city's urban formation. According to Hanson's research (p.394), there are four features of the central London grid which stand out and persist historically (see Figure 16): the predominately east-west oriented organisation of the street network; the Newgate/Cheapside line's key role in keeping the system well-connected; the morphological distinction of four fundamental districts; and finally, the less connected, or syntactically 'segregated', periphery of the city.

Figure 16. The City of London: historical grid features.

Redrawn based on Hanson (1989, p.325-328).

Of course, London has grown dramatically since those very early years of its historical core. Growth has gradually displaced the city edges as London has spread out and encompassed the relatively self-contained settlements located beyond the city fringe (Vaughan et al., 2010). The complexities of the London suburban formation are addressed in Vaughan et al. (2009a) where the authors argue that the theoretical basis of suburban studies needs to be reconsidered focusing on the suburban specificities. The morphological processes that merged the outskirts with the city suggest that suburbs have clasped along and around the main foreground lines of the

London street network, absorbing urban change whilst sustaining aspects of local life (c.f. Griffiths et al., 2008; Vaughan et al., 2009b; Vaughan et al., 2013).

Considering these studies, a fundamental diachronic property of the London street network is understood: while London's urban parts are morphologically diverse, they physically merged throughout the city's spatial history (Hanson, 1989, p.329) and are held together by the spinal structure of the grid, interlaced with its foreground network of primary street arteries. This suggestion is further supported by the syntactical reading of the present London grid provided by Hillier et al. (2012) mentioned in the first part of this chapter. The authors reflect on the structure of a city found beyond the apparent order of the city grid. In the case of London, their analysis confirms the predominance of the *whole* over the *parts* through a strong foreground network which stands out from the background localities: morphologically strong, in the sense that it is comprised of longer, and closer to linear, street arteries; and syntactically strong, in regards to those streets' relation with surrounding urban parts and the city as a whole – for instance, these are streets that present higher movement potential.

The structure of the London grid is organised over time upon a functional *hierarchy*. The importance of streets within this urban configuration is distinct and clear. In a sense, the spatial programming which defined the domestic layout is a feature observed at the city scale as well. This observation relates to Hillier and Hanson's understanding of architecture as a *morphic language* (1984, p.48), namely as the ordering of entities into varying arrangements based on a syntax in a way that 'social knowables' are formed. The authors explain that *'[e]ach society constructs an 'ethnic domain' by arranging space according to certain principles'* (*ibid.*). Davis (2006, p.99) makes an insightful observation regarding the historical architectural ideas that shaped the London building culture. The author writes that these ideas are bound with the concept of *classification* and are implemented as early as the seventeenth century with the Act for Rebuilding the City of London of 1667 (for instance in the classification of houses and streets). Davis explains: *'These architectural ideas are essentially Enlightenment ideas, in which formal classification begins to fragment a formerly unified picture of the world.'* (*ibid.*) In other words, this concept of classification is translated into spatial, morphological and functional hierarchies when it comes to the London building culture.

3.3.2. Manhattan grid

Upon the first encounter with the Manhattan plan, four elements stand out (not necessarily in this order; see Figure 17): the regularity of the Commissioners' street gridiron; the Lower historical part which deviates from the grid; the 'disobedient' Broadway which crosses Manhattan diagonally; and the green field of Central Park. In other words, what stand out are the city's two-dimensional orthogonal order and any feature divergent from this order. In its two dimensionality, the city is at once perceived and understood as a readable, logical, regular diagram. The Commissioners' blueprint makes Manhattan a neat example of *the architecture of the urban object,* as Hillier would put it (1989; 1996): a city being treated in its whole as an 'object' by design. As mentioned earlier in the discussion on the rules of aggregation in the Manhattan row housing schemes, the primary and most dominant element in this 'urban object' is its street gridiron.

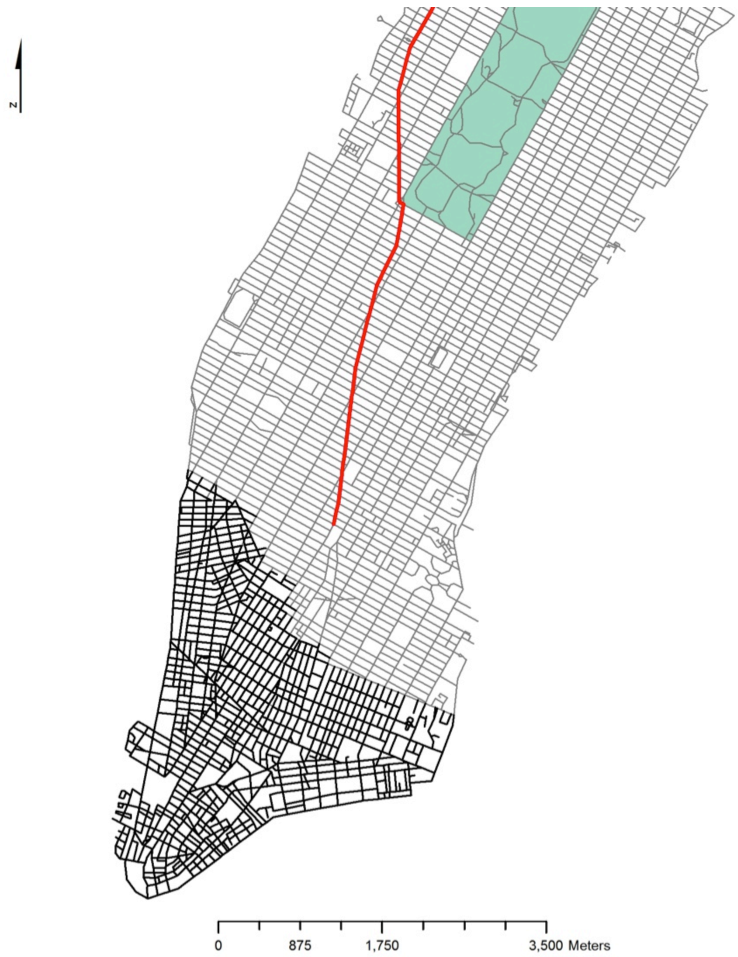


Figure 17. The Manhattan grid.

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

In 2011, the Manhattan grid celebrated 200 years of existence. *The Greatest Grid* (2012), edited by Hilary Ballon, is a publication dedicated to these two centuries of Manhattan master plan. The book covers all possible aspects related to the *Grid*, such as the surveying of the city's street configuration and topography, the system of street openings, the land subdivision in plots, and improvements and later modern reforms. An aspect which becomes clear in the retrospective is the high consideration among New Yorkers of the significance of the street in a city's function and utility. Even before the Commissioners' plan *'the whole urban engine of New York depended on a functional street system: streets to circulate merchandise, to access building lots, and to shop and live on. The streets were the lifeblood of the city.'* (Ballon, 2012, p.17) Governmental actions after 1800, prepared in a sense the ground for the 1807-11 Commissioners. In *The Greatest Grid* it is mentioned:

> *'The streets were increasingly recognized as a public responsibility. In 1803 the Common Council condemned streets that 'served only their private advantage, without a just regard for the welfare of others, and to the almost total neglect of public convenience and general usefulness.''* (*ibid.*)

These first seeds of spatial awareness – in favour of the city's prosperity as the future aim – were further cultivated by the visionary planning of 1807-11. Beyond debates regarding the scope and the failures of the Commissioners' plan[18], one thing is accepted without a doubt: the city was planned as an engine, set to generate its own greatness; and so it did. An impressive aspect of Manhattan's greatness and workings is that despite its affirmative two-dimensional order, the grid has supported over time a highly probabilistic space of functional and architectural emergence and diversity. Space is organised, but it lacks a strong hierarchy. When analysing the Manhattan *street syntax* the relative absence of hierarchy is confirmed. In contrast to London's clear syntactical demarcation between foreground and background street structures, in Manhattan, the line of Broadway is slightly more pivotal to the grid but still not greatly differentiated from the rest of the city streets (Hillier et al., 2012). In other words, the foreground-background distinction in the street syntax is toned down. As a consequence, the formation of distinct urban parts is also spatially very weak. Overall, the urban whole (the city-wide scale) predominates via its 'top-down' design.

[18] See for instance Reps's criticism of the grid in *The Making of Urban America* (1965, p.132).

There is, however, an implicit hierarchy traced in the *morphology* of the city elements. This derives from the differentiation in street widths and their associated building heights (Ballon, 2012, p.87). The north-to-south avenues are wider and built up by taller buildings, in comparison to the east-west streets where building development is of a smaller scale. Over time and with the influence of zoning legislation, a functional hierarchy grew, with stronger commercial activity along the avenues and a primarily residential character in the interstices.

The structure of the Manhattan grid assumes similar potentials for the city streets. Their importance within the urban configuration is weakly differentiated, while this is mainly achieved through morphology rather than configuration. In a sense, just as in London, the spatial logic of the city scale presents a continuity with the principles that organise the domestic interior: the weak spatial programming observed in the domestic layout is a feature found in the city grid as well.

3.4. Form, configuration and ideas

In her book *Margins of Desire* (2005), Lynne Hapgood develops the implications for the notions of the 'ordinary' and the 'extraordinary' – in the context of the suburban literature. Commenting on the novels of Arnold Bennett, Hapgood writes:

> *'In Bennett's novels, the ordinary is a material fact which relates to jobs, family, location, class – all the familiar makers of social identity […] What makes Bennett's characters extraordinary is their own sense (not Bennett's) of the uniqueness of their experience and the importance of their lives: they do not think that they are ordinary.'* (p.220).

The metropolitan development of London and Manhattan was set off from *ordinary* vernacular building cultures. A great deal of what makes these urban settings *extraordinary* comes from the restless visions sheltered in their urban form – and, as this thesis will argue, from the probabilities emerging by the building morphology.

Each case's *historical morphological identity* is revealed and in turn the juxtaposition is noted:

- London presents a visible order when it comes to the architecture of the terrace, whereas order becomes almost invisible in regards to the city grid. The London map appears as a random patchwork of urban parts. However, by parsing the street syntax, the two-dimensional structure of the city is understood. London, as Hanson argued, is configured by a diachronic spatial hierarchy which distinguishes the foreground city network from its background parts. London's growth allowed for spatial emergence, especially at the level of the street pattern. This emergence adjusts and assembles through historical processes the parts within the whole.

- On the other hand, the Manhattan row is more loosely ordered in its architectural appearance, whereas the Manhattan grid is a rigid manifestation of an ordered system. The Commissioners' plan represented a 'top-down' design act which treated the city scale as an entity. This two-dimensional order is not translated into hierarchy; rather, Manhattan is structured in a way which diminishes the contrast between the background and foreground city networks. Manhattan's planned development allowed for spatial emergence, especially at the level of the built volume. This emergence moulds the built form's third dimension with a relative hierarchy, but mostly with infinite architectural variation (Koolhaas, 1994).

At the same time, each case's *historical spatial culture* is revealed – namely the way each urban setting has ordered its space in order to configure *'the principles for ordering social relations'* (Hillier, 1989, p.6). Remarkably, from the dwelling interior and up to city realm, the socio-spatial tales of these two examples follow in each case a cross-scale consistency:

- The London domestic interior organises and controls family life; users follow pre-set spatial formalities and narratives in their everyday life. Respectively, the terrace as a socio-spatial entity dominates the single terraced house: it could be said that the terrace resembles a single building occupied by a single social-class (rarely, a mix of different classes). The city structure also follows a marked hierarchy, one that assigns specific significance to urban streets.

- The Manhattan dwelling is more user-oriented; the family narratives and their reproduction do not necessarily always follow the same pattern. As one scale beyond the dwelling, the row is treated as an assemblage of individual row houses organised by the same rules, whose austerity, or grandeur, depends on architectural style and social class. Lastly, the city's design embeds ideas related to spatial equality, to the generation of equal economic opportunities amongst the street grid.

Overall, London and Manhattan consist urbanities faithful to their cultural profile across all spatial scales; across form, configuration, and ideas embedded in space. Many of the theoretical notions discussed in this chapter concerned *morphological order*, *spatial hierarchy* and *grid structure*. All these ideas were considered alongside and in reference to one another in an effort to link the architectural, morphological and syntactical origins of London and Manhattan. In a sense, this chapter prepared the ground for the methodological standpoint of this thesis, which is presented in detail in the next chapter. This standpoint aims mainly to relate ideas rather than to exhaust specifications; it aims to address *structure* in its broader sense. In *The Metapolis Dictionary of Advanced Architecture*, the following definition is offered for the term:

> *'Structure is a network of connectivity. An argument has structure, so has a building. From abstraction to concrete realisation, structure joins discrete ideas or elements into a coherent entity.'* (Gausa et al., 2003, p.575 quoting Balmond)

This research looks at urban space as a field where ideas and elements are brought together and work with (and against) each other over time, producing varying urban situations. This wider definition of structure is adopted here not just when considering the building scale, but also in expanding the analysis to foster an interpretation of the way spatial scales relate to each other. The term is considered in its wider sense, in the context that structure is the underlying logic which holds elements together in coherence. Subsequently, when investigating *the structure of the street interface* it is suggested that a methodology cannot simply break apart the fundamental elements, namely the *buildings* from the *street*, and study them separately. On the contrary, the principles affecting the socio-spatial performance of each element need to be considered side by side. Each element has its own profile: its syntax, morphology, social context and history. And then, there is the elements' historical interaction.

Effectively, this means that the street interface needs to be understood all together as the product of building form, street network, building function and time.

As mentioned in the beginning of the chapter, this study focuses on two specific areas within London and Manhattan: namely, Islington and the West Village respectively. Both areas contain a wide range of street vistas: from short terraced/row house façades to postmodern solid block fronts, and from wholly domestic settings to streets lined with shops and businesses. Islington and the West Village have undergone a series of built form transformations to the point where conservation policies have been implemented in order to mitigate the effect of urbanisation on historical buildings. The specific reasons that make Islington and the West Village relevant to this research are further explained in the opening sections of the two analytical chapters (Chapters 5 and 6). However, before moving on to the analysis, the methodological approach is clarified – in Chapter 4.

4

Chapter four - Components, relations, time – the approach

This chapter sets out the methodology applied in the analytical chapters which follow next (Chapters 5, 6 and 7). The discussion outlines the background research context which has guided the methodological approach and decisions, to then unfold step by step the specific analytical techniques used by the study to examine the street interface properties and urban transformations in Islington, London and the West Village, Manhattan.

4.1. Methodological background

4.1.1. Research inquiries and topics

The four main research questions that the methodology aims to address – as these were described in the introduction of this thesis - concern the following:

- *Firstly*, the role of built form in shaping street activity;
- And, the role of the street network in shaping street activity;
- *And secondly*, the role of built form in the patterns of morphological and functional change in the streetscape;

- And, the role of street network in the patterns of morphological and functional change in the streetscape.

These main inquiries are adherent to two research topics which need to be methodologically approached: the street interface and built form change.

The street interface

Lying at the heart of this study is the proposition that the encounter and co-presence patterns at the street domain are the product of both city-wide connections and local building morphology. The street network shapes the potential distribution, co-presence and mixing of locals and strangers within the whole urban system (c.f. Hillier and Hanson, 1984; Hillier et al., 1993; Hillier, 1996; Hillier and Vaughan, 2007). On the other hand, the aggregation of building elements (buildings and plots) organises the proximity and density of building entrances; in turn, the pattern of building entrances shapes the potential presence and co-presence of individuals in the immediate environment (Hillier, 1996; Hanson, 2000). Acknowledging both these aspects of urban space, the analytical approach suggested in this thesis aims to consider not only the potential for virtual encounter emerging from the street layout and its effect on pedestrian 'natural movement' flows (Hillier et al., 1993), but also to take into account the system of interior-exterior encounters shaped by built form and block-street interface. In *The Social Logic of Space,* Hillier and Hanson (1984, p.143) note: *'A settlement, as we have seen, is at least an assemblage of primary cells, such that the exterior relations of those cells, by virtue of their spatial arrangement, generate and modulate a system of encounters.'* In other words, the effort here is to consider both the syntax of the two-dimensional configuration (street grid), as well as the syntax of the three-dimensional morphology (buildings).

Passing from *axial* analysis - that refers to a straight street line - to *segment* analysis (Hillier et al., 2010) of street parts, space syntax methodologies provide the tools for a refined reading of the street grid structure. Segment analysis allows for network calculations (for instance, in terms of accessibility) considering physical distance at different spatial scales (for example, at a given number of metres from each street segment). Research using these methods has showed that streets with greater levels of accessibility attract proportionately larger flows of movement. While descriptions and insights concerning the two-dimensional properties of the street network have been developed for many years in space syntax research, the relation of the grid to the three-dimensional organisation and properties of buildings has not to date been explored to the extent presented here.

Built form change

Streets are complex artefacts. Undeniably, preceding *time* is a crucial factor for any 'present' image of the streets. Built form is a carrier of the urban past, and in turn, history imprints on the morphology of buildings (c.f. Conzen, 1966, 1988, 2004; Caniggia and Maffei, 1979). Over time urban places can become more or less vibrant, or remain more or less the same. Here – similar to the approach regarding the properties of the street interface mentioned above – the interplay of street network properties and building morphology is considered to be associated with urban change. Whilst change becomes tangible and observed in the built form, it is suggested that the patterns of urban change are strongly related to – and in some cases, even generated by – the street layout.

This is not a new idea within the space syntax studies' spectrum. Indeed, from a 'space syntax' point of view a central process throughout urban formation is 'the multiplier effects' (Hillier, 1996; Hillier and Vaughan, 2007); namely, the interrelation of varying factors which influence one another over time. Pedestrian movement and land use attraction are for instance two such well-know collaborative factors. In other words, there is the acknowledgement that things change over time and they are the outcome of accumulative urban processes. However, there are two main inquiries adherent to this observation which remain so far less investigated from an *analytical* perspective: one refers to the role of *historical processes* in shaping the urban streetscape, and the other to the *patterns of built form change*. These inquiries point towards a historical study of morphological and configurational processes of continuity and change, and their socio-spatial outcomes. The potential contribution of space syntax analysis has been suggested by evidence-based research on varying topics: on the impact of grid transformations on the *conservation*, continuity and change in *historical city centres* (Karimi, 1998; 1999); on the growth processes of *suburban morphology* (c.f. Griffiths et al., 2010; Vaughan et al., 2013) and *industrial cities* (Psarra et al., 2013); on the *diachronic processes* of urban growth (Griffiths, 2009); on *building adaptation* in terms of demolition, modification and use change (Törmä, 2014). These studies highlight that built form transformations need to be traced through a historical study and to be considered in relation to the street network.

4.1.2. Approaches for studying urban space

In order to address these topics the study looks at urban elements (buildings, blocks, streets) combining three methodological perspectives:

1. **Syntactical-analytical:** methods and tools from this category address the organisation and relational aspects of spatial patterns. The syntactical-analytical approach is based on space syntax theory and the notion of *spatial configuration* which considers space as a system of relations that take into account other relations (Hillier, 1996, p.24; Hillier and Penn, 1991, p.30). Syntactical analysis provides a thorough and rigorous understanding regarding both the workings of spatial patterns per se and the relationship between space and society as well. Space syntax tools are considered useful also for the conduction of comparative analysis: syntactical measures reveal potential generic properties of spatial layouts; and conversely, these measures provide insights in relation to potential culturally oriented elements. With the use of space syntax tools, consistencies and differentiations across different historical periods and across different urban cultures can be revealed.

2. **Morphological-architectural:** methods and tools form this category address geometric and aggregative properties of urban form. The morphological approach refers to the use of established descriptions and representations coming from the process typological and historico-geographical approaches in urban morphology (Kropf, 2009). Such approaches study the morphological properties of buildings, plots and street structures (c.f. Conzen, 1960; Caniggia and Maffei, 1979; Korpf, 1996; Çalişkan and Marshall, 2011). This enables a consideration of the dialectic relationship between built form (buildings) and open space in urban systems (streets). Furthermore, this type of analysis can reveal the ways design (or morphological rules underpinning design) might affect the organisation of the built environment (layout of plots, blocks and urban grid respectively) over time. Land use studies are also part of the urban morphology methodological tradition providing a description of the socio-economic function of spatial patterns (Conzenian approaches). Finally, while the space syntax approach studies the configurational properties of spatial patterns, the process typological and historico-geographical approaches in urban morphology examine the geometric properties of built form. In this way these fields are complementary.

3. **Historical:** this last level of approach refers to the analysis of urban transformation processes, from the past until the present. There is not an established way of applying historical research (the Historical Geographical Information Systems (HGIS) research network tries to address this but the problem of source material availability remains). However, a common methodological ground in historical research is the comparative consideration of different time periods in the history of the studied object. The scope of research guides the sources and the kind of data to be pursued. In this case, the methodological approach aims to retrieve historical data which can provide references for the syntactical, morphological and socio-economic urban past of each case study. Here, the aim is not to simply present history as a background to this research, but instead to examine in a systematic comparative way how urban space changed over time. Such an exploration can inform the understanding of the present urban form and function and of urbanisation processes in general.

With the use of *tools*, *measures* and *descriptions* reflecting these thematic approaches this study will establish whether it is possible to identify *the interplay of built form and street networks*; and next, analysis will examine their *historical* interplay – looking at Islington and the West Village. The mingling of analytical with empirical approaches with regards to urban phenomena is a strong characteristic of the explorations throughout; its potential limitations are further discussed later in this chapter. Data which inform both *quantitative* and *qualitative* descriptions were collected and processed. These refer to spatial, physical and socio-economic properties of the two case studies. Due to the nature of this research, data collection and processing for this particular study have been extremely laborious and time-consuming. Finally, a special characteristic of the methodology is the *high resolution, block scale analysis*. Subsequently, it is important to note that the centre of attention is not the city scale, the urban whole; the focus lies on the *micromorphology* of the sidewalk at the scale of the *street segment* (namely, the block scale), whereas the city scale is used to inform the understanding of micro-transformations manifested in the local scale.

The next two sections summarise the way this multileveled methodology is articulated and applied within the specific context of this study – which is on the one hand the micromorphology of the virtual community and on the other the historical built form change. This summary explains what is to be anticipated in the analytical chapters.

4.2. The street segment as composite unit

Marshall defines the *'fundamental urban units'* that come from the following three different spatial categories: *the three-dimensional units*, *the two-dimensional units,* and *the linear units* (Marshall, 2009, p.60-68).[19] These are: the individual buildings, plots of land, and routes, respectively. Notably, they form a 'city-shaped' urban order by creating in turn composite units such as streets and squares. The author particularly emphasises the structural role of streets. Streets are suggested to be *composite units* that serve as a 'building-block' by connecting plots, routes and buildings (*ibid.*, p.79). Accordingly, the study here takes the *street segment*, namely the street section between two junctions, as its unit of analysis. In space syntax analysis, the street segment is the primary configurational element of the street network. However, the approach here extends the notion of the street segment to include the building elements which define the segment's physical space (Figure 18): each street segment is considered as a *composite unit* which is configured by two block sides (accumulation of building units at either street side) and the open space within (namely the entirety of the pavements and the street). Consequently, the analysis looks both at the spatial/configurational network properties as well as the morphological properties of the buildings facing a street segment.

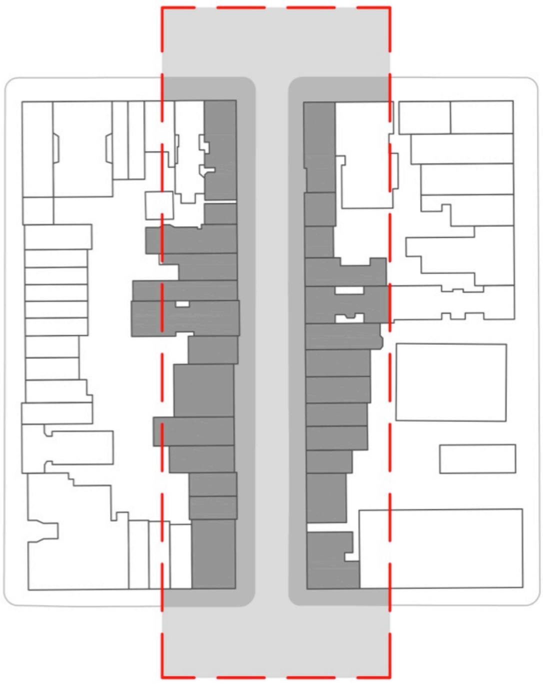


Figure 18. The street segment as composite urban unit.

[19] See also Conzen, 1960, p.5.

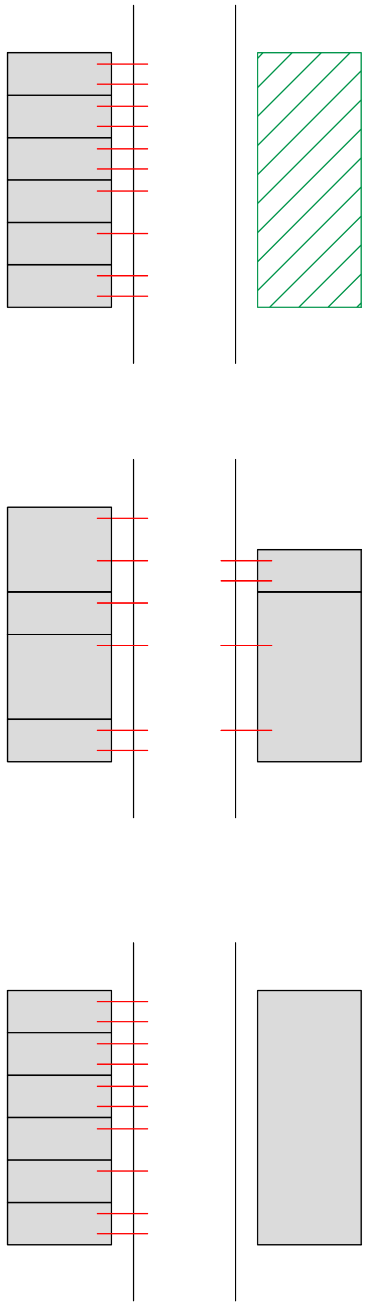
4.2.1. A reading of the streetscape – problem definition

Considering the street segment as a composite urban unit, means that the particular characteristics of each street segment side are to be taken into account. To illustrate this suggestion, we can look at a stretch of Bleecker St., in the West Village, Manhattan in Figure 19 showing varying street qualities along the same street line. More particularly, these comprise:

1. A street segment where on the one side one finds many buildings arrayed (with many entrances) and on the other a park/open space.
2. A street segment where many buildings (with many entrances) align it on both sides.
3. A street segment with many buildings lined up (with many entrances) on the one side, while on the other side lies a single building covering the whole side of the block (with few entrances, or none, or many).

Figure 19. Bleecker St., the West Village, Manhattan; built form variations along a street line. (c.2011)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.



Calculating each segment side separately:

1. Park on one side

side 1 = 10 doors / 6 buildings = 1.66

side 2 = 0

TOTAL = 1.66

2. Buildings and doorways on both sides

side 1 = 6 doors / 4 buildings = 1.5

side 2 = 4 doors / 2 buildings = 2

TOTAL = 3.5

3. Buildings on both sides, doorways on one

side 1 = 10 doors / 6 buildings = 1.66

side 2 = 0 doors / 1 buildings = 0

TOTAL = 1.66

Figure 20. The street segment as a *composite unit*: buildings and doorways.

These different cases in terms of block frontage and the configured segment-block interface cannot be described by just looking at the total number of doors in relation to the total number of buildings for both street sides together (namely by calculating the doors/buildings ratio for each street segment – this is similar to the measure used by Julienne Hanson called ‘neighbourliness score’; Hanson, 2000). Even taking the *total number of doors/total number of buildings* ratio for each street segment *side* would not really be representative of all urban situations. Consider the following example: a street segment side built up with a long building façade having one entrance versus a street segment side with a park and only one small building counting one entrance as well (Figure 20). Despite their differing morphological properties, the doors/buildings ratio would be the same for both these cases.

Overall, studying the street segment sides separately means examining the *micromorphology* of the block front. Effectively, it becomes possible to avoid oversimplification of the urban situation and to consider the potential differences between street parts in a more detailed and realistic way.

4.3. Tools, measures and descriptions

4.3.1. Street network analysis

This part refers to syntactical analysis of the configurational properties of the street network. In order to perform space syntax analysis for a city grid, the street network needs to be represented in terms of *accessibility and visibility* relations, namely in terms of *axial lines*. This new syntactical map representation is imported in DepthMap software, where calculations for the various space syntax measures are produced automatically. Further developed space syntax representations of the city grid introduced the *street segment* as a unit of analysis. A street segment is the street part defined by two street junctions in sequence, or a junction at the one segment end and a dead-end at the other. Still, the segment map is the product of an axial map; therefore when referring to ‘streets’ here, we actually mean their linear representation – the axial line. Segments are essentially the parts of subdivided axial lines (Figure 21). All DepthMap calculations are based on the production of such urban models.

The models can refer to a whole city or just a city part. For London, the syntactical maps extended beyond the studied area by a factor that takes account of the maximum radius of analysis (Dhanani and Vaughan, 2013), as well as geographical features – for instance, Thames river defines the southern edge of the map, while overground train lines are used to specify the boundary of the map at the west and northern sides. In this case, the map was extended by approximately 3000 km and the maximum radius of analysis is 2500 km. In this way calculations do not reach the edge of the map (which is not the actual edge of the city). For Manhattan, in order to take into account the geographical particularities of New York, the syntactical map was drawn for the whole Manhattan borough. The maximum calculations reached to a catchment of *radius n* (namely, they cover the whole map), so as to include in the analysis the spatial limitations of Manhattan being a fixed grid (surrounded by the sea). In this case, the edge of the map coincides with the edge of the borough.

The study uses *segment* scale analysis, and more particularly *segment angular measures*. The reason measures are called 'angular' has to do with the way relations of 'distance' are calculated (see Figure 21). In segment *least angle* or *geometrical* analysis *within a metric radius*, distance refers to the degree of angular deviation between segments. For instance, two segments forming a straight line, would present a zero degree distance. *Metric radius* defines how far within the urban model the analysis will reach. The *least angle analysis* appears to reflect in a more faithful way people's navigation within urban space (Hillier et al., 2010).

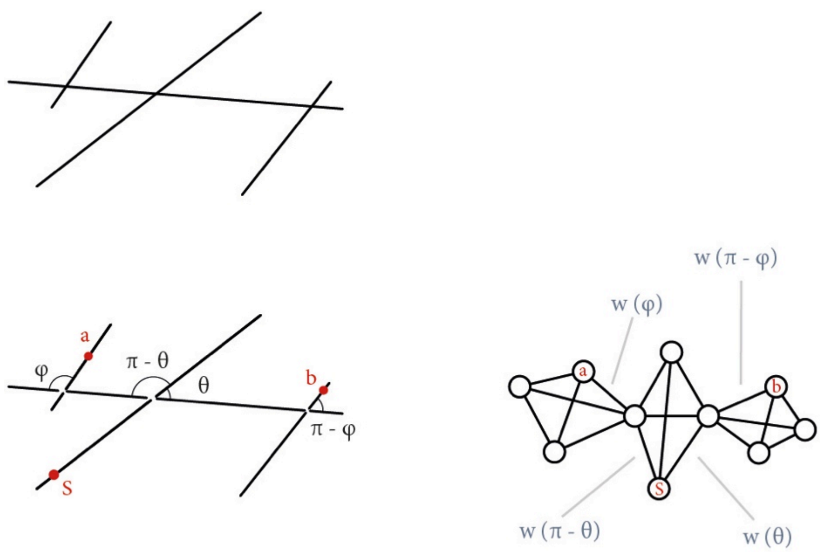


Figure 21. From the axial line model to the segment model.

Redrawn from Figure 1.6, *The City as One Thing*, Hillier and Vaughan (2007).

There are two fundamental space syntax measures when it comes to urban analysis: *integration* and *choice*. When calculating integration, results measure each segment's closeness to all other segments found within the analysis radius. *Integration represents to-movement potential*, namely the segments' probability to serve as destinations within a system of pedestrian routes. When calculating choice, results measure the degree to which each street segment is part of least angle routes within the city grid; namely, routes that approximate a straight line (Hillier et al., 2010). *Choice represents through-movement potential*, namely the segments' probability to serve as a passing through route. A detailed account on space syntax methodology can be found in the textbook by Al_Sayed et al. (2014).

Throughout the study the following syntactical measures are used: [20]

- <u>Combined integration and choice</u>

The combined calculations for integration and choice show each segment's potential for *both* to- and through-movement. Combining integration and choice is used in the analysis to examine the way the street segment is generally situated within the grid – to form an overview of the potential spatial prominence of each segment within the street system. The higher the values, the higher the probabilities for the street segment to form part of a larger set of spatial relations within the street network. The measure is used extensively in this study when studying the maps separately in order to relate the general syntactical characteristics of a street segment in terms of the street network with the properties of the street-facing building morphology.

- <u>Segment Length Weighted integration and choice</u>

One of the efforts to improve the syntactical measures' efficiency has been the *weighting* of calculations by segment length. This advancement is based on the idea that longer segments are more likely to have a higher number of buildings, and therefore they are considered more prone to generating movement – both as origins and destinations points within the urban grid. In this sense, the measure provides a more objective way to compare the spatial properties of segments of different length. Therefore the segment length weighted measures were used in the particular occasion where the street segments of Manhattan where examined in terms of *segment length* and the potentials for permeability and accessibility they present within the street network (Chapter 6A).

[20] See Appendix A1 for the mathematical function of the syntactical measures.

- Normalised measures

Hillier et al. (2012) introduced the normalised measures in order to take into account the size of the analysed grid when performing calculations; namely, in order to take into account the effect of *depth*, of the number and size of the probabilistic routes within a street configuration. Effectively, the normalised measures allow for comparison between street networks of different sizes (or depths), such as smaller and larger cities or even the same city in different periods of its growth. These measures are of great importance to this study, both because they allow for comparative and temporal analysis, as well as because they have been shown to reveal aspects of the city's street structure (*ibid.*).

Scales of analysis: Radii studied for measures

The radius of analysis refers to the catchment of calculations, to the distance up to which the analysis will reach (starting from each street segment to all others). In general, two scales of analysis are discussed: the local scale, for considering the network relations within the studied urban areas; and the wider city scale which calculates the network effect for each area's wider surroundings – or in other words, the way the studied area is connected up with the city. For the local area, analysis extends to the radius of 800 meters which is considered representative of a walkable distance (Vaughan et al., 2013). For the wider city scale, for the case of Islington, where the segment map covers a radius of approximately 3km around the case study area and not the whole of London, calculations extend to a catchment of 2.5km in order to avoid edge effects; for the case of the West Village, calculations extend up to including the whole Manhattan map (radius n). In the comparative analysis of the two case studies (presented in Chapter 7) – which relates street interface properties to street network and building morphology – calculations are performed for radius 2.5km in order to allow comparisons.

Mapping the space syntax maps to other data

Space syntax analysis results are further explored in relation to the following studied properties of the street interface:

- Land uses
- The type of interior-exterior transition (direct or indirect)
- The frequency of entrances
- Incidents of built form change

Quantitative data for describing the various street interface properties are related to the street network configurational properties via descriptive statistics. Using a geographical information system (GIS), individual and composite properties were tied to the linear model of the street network to enable space syntax analysis to be carried out according to each segment's spatial, morphological and land use characteristics. In other words, to 'link' the quantitative data to each street segment, the syntactical map was imported into the ArcGIS software, georeferenced and then connected to the various mapped data (i.e. building entrances and building facades).

However, this process presented a difficulty in terms of separating calculations for each street segment side. In order to achieve this separation, buildings (along with the associated data: thresholds, uses, type of interior-exterior transition, façade length, building types) where manually split in two different layers within the software (side one and side two) (see Figure 22). The properties of each street side were then calculated separately in relation to the street network properties.

Figure 22. Separating street segment sides in ArcGIS software.

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

4.3.2. Built form analysis: the micromorphology of interior-exterior encounters

With regards to built form analysis of the street interface the methodological tools and measures developed here aim to examine built form in terms of probabilistic interior-exterior encounters; namely, to examine the micromorphology of the virtual community *configurationally.* This implies the investigation and measuring of built form properties which relate to the structure of the building-street interface at the level of the ground floor.

Relations of density, proximity, articulation and diversity

Here the study focuses on the very elementary-syntactical properties of the building-street interface; therefore, it looks at *accessibility* relations between the building interior and the street domain. Accordingly, only the architectural elements which potentially affect the frequency and configuration of the building threshold in terms of accessibility are discussed. These features are considered to affect the materialisation of the building-street interface, and consequently, of the sidewalk overall, at a generic level – namely, in terms of defining the potentials for *density* and *immediacy* of the probabilistic encounter field between buildings and streets. In general, these features concern the *physical* properties of block fronts. These are different from the *spatial* properties of street segments. The latter refer to the syntactical properties of street segments which define the segment's role as a *destination* and/or *route* within the street network (see earlier in section 4.3.1). The next paragraphs describe the physical properties considered by the analysis.

Encounters as the probabilistic product of morphology

Considering user encounters as the product of morphology implies specifying the fundamental properties of block frontages which relate to the presence of building thresholds alongside sidewalks. As specified, the unit of analysis for exploring the sidewalk particularities is the street segment side. It is suggested that in order to 'read' the block front-street relation in terms of the virtual community, the very fundamental properties to consider refer to the number and the physical proximity of building thresholds. Respectively, the two primary factors to be taken into account are: (1) an indication of the block frontage length[21] in relation to segment length, and (2) the frequency of building entrances.

[21] The sum of building façades' widths facing the segment.

Figure 23. Mapping the micromorphology of the virtual community.

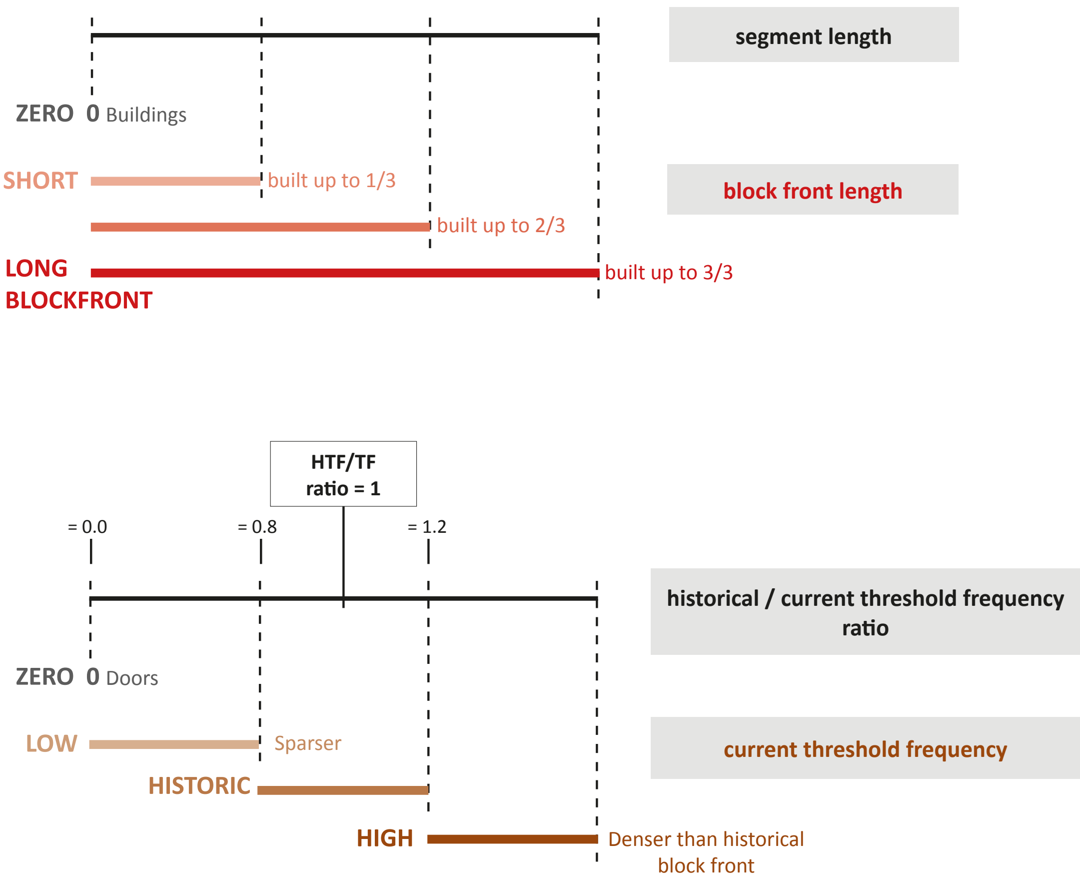


Figure 24. Measuring street interface density.

Block front / segment length (*bf/sl*) ratio

This simple measure provides an indication of the extent up to which a street segment side is built up. The block front length is the sum of building facade widths facing the street side. The segment length equals the length of the segment line. The segment line is specified by the segment model (the segment map) which was used for syntactical calculations in DepthMap. If the ratio equals 'one' (*bf/sl* = 1) this means that the whole segment side is built up with buildings, while for a 'zero' result (*bf/sl* = 0) the implication is that all lots along the street side are empty of buildings. Block front length and segment length are measured in meters.

Threshold frequency (*tf*)

This is another straightforward measure which calculates on average the spacing between building thresholds (in meters); or in other words it provides an estimate of how frequently is a building entrance anticipated across each studied block front. Threshold frequency is calculated *dividing the block front length* (in meters) *by the total number of building entrances* recorded along this block front. Lower values imply higher threshold frequency, and hence, a denser block front in terms of potential interior-exterior encounters.

Door encounter rate

This measure is essentially a generalisation of the *threshold frequency* measure. *Door encounter rate* is used by the analysis in order to provide an overview on average of the streetscape and the frequency in building entrances. Door encounter rate is calculated when *dividing the sum of building facades' widths (in meters) by the total number of building entrances* recorded along those façades. For instance, the measure can be used to estimate the average frequency of entrances along streets or urban areas, or even to estimate the average frequency of entrances for particular building typologies. This measure assumes a streetscape with an even building threshold distribution across streets (and street sides), which of course is not the case when moving about urban space. Similarly, when used to compare the frequency of building-street connections for particular building typologies, the measure assumes a streetscape built up with a single building type; again, this is not close to reality. However, this measure provides a basic indication of the buildings' openness towards sidewalks and consists a useful starting point for comparisons.

Historical threshold frequency / Threshold frequency ratio (*htf/tf*)

In an effort to define what can be considered as ‘high’ or ‘low’ frequency of building thresholds, the requirement for a standard came up; namely, if considering a typical urban settlement, which would be the anticipated frequency of building-street connections? It was decided that a valid reference point for assessing threshold frequency was *the properties of the historical built form*, the historical ordinary building unit. For the case of Islington, London the historical building unit is the terraced house; for the West Village, Manhattan the historical building unit is the row house.

This decision has twofold gain. Firstly, it is not dismissive of a settlement’s morphological particularities. Namely, this standard can change depending on the building culture of the studied area, and thus, the method can be adjusted to fit varying built environments. Secondly, when using this standard, there is inherent in the measure’s definition a comparison between the threshold frequency of the historical and the current built form.

Essentially, this measure points out whether current block fronts are denser in building-street connections in comparison to a typical historical block front. This can be found out when *dividing the historical threshold frequency with the current threshold frequency*. It is understood that this is not a precise measure for comparing the past and present properties of a street segment side, as calculations are not based on a detailed record of building entrances for the historical built form (rather on hypothetical estimate). The study considers a standard of one doorway per historical façade width, since both typologies were firstly built up in both case study areas as single-family dwellings (namely, a doorway per terraced house or row house). In particular, based on the façade width of the remaining terraced houses in Islington a doorway per 5.8 m is considered the standard; and respectively for row houses in Manhattan, the historical threshold frequency is set to a doorway per 6.4 meters (21 feet).

Historical threshold frequency / Threshold frequency ratio of *primary* entrances (*htfp/tfp*)

This measure is the same measure as the *historical threshold frequency / threshold frequency ratio* described above, but this time considering only direct building street connections; namely it captures the *immediacy* of the street interface.

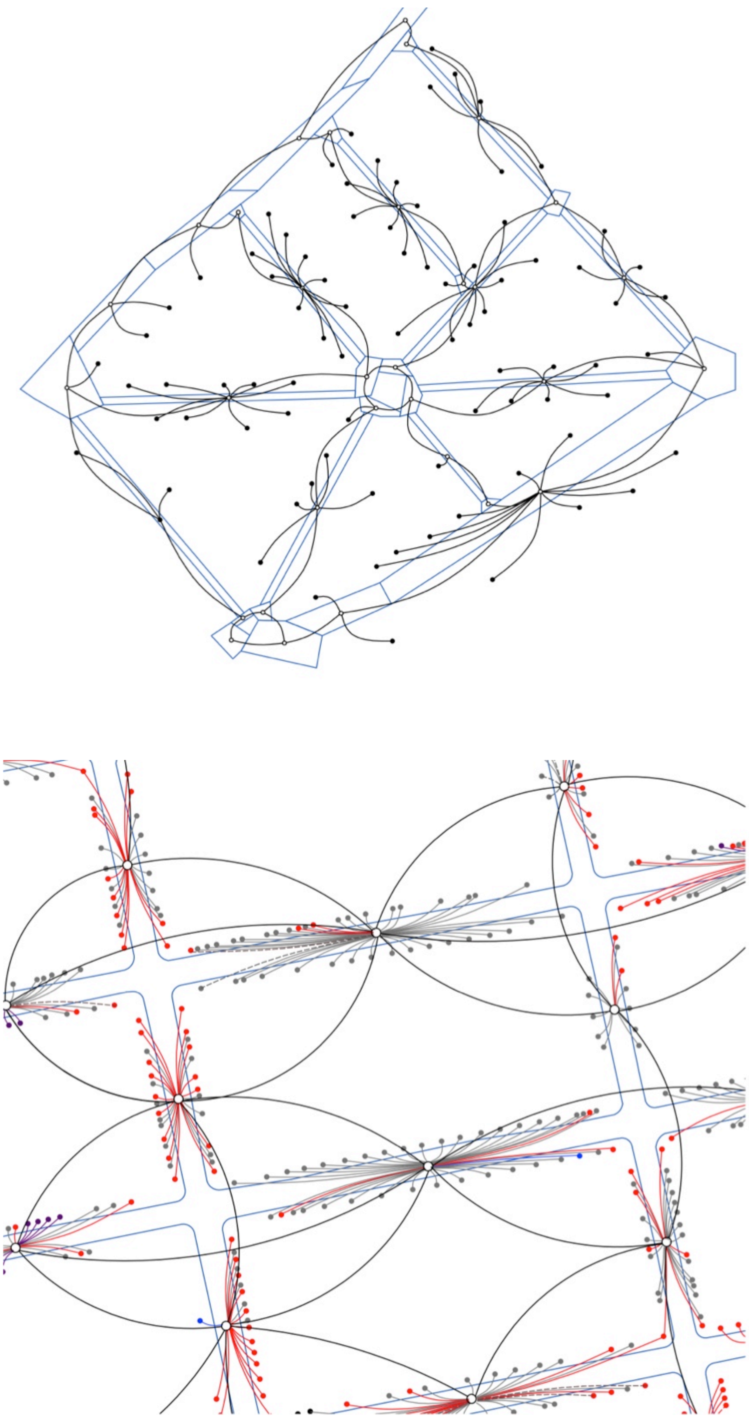


Figure 25. The interface map informed.

Showing an example of the older version of the interface map (top) (used by Hanson, 2000) and the development made here (below).

Interface density

Overall, the term *interface density* is used to describe the properties of a street segment side both with regards to how much built up the street side is and how frequent the building thresholds are within the block front. Interface density is a description, not a numeric measure based on values per se.

Threshold map

All the aforementioned data are collected from a mapped record of building thresholds. The map records the approximate location of building thresholds in the studied area, the land use associated with each threshold and the type of transition (namely whether the threshold consists a direct or indirect building-street connection). In this sense, the threshold map here is an 'informed' version on the 'interface map' introduced in *The Social Logic of Space* (Hillier and Hanson, 1984, p.104) and extensively used by Hanson (2000) in her study of the street interface (Figure 25).

Encounters and building function

To address the way physical properties of the street interface relate with function, purpose and utility the study looks at the way building function impacts on the configuration of the building-street transition; or in other words, the private-public transition. As discussed in the theoretical section, there is one basic distinction in the way building-street access is structured: whether accessibility is achieved in a direct or an indirect way. In other words, whether thresholds consist direct/primary building entrances or indirect/secondary thresholds (Hanson, 2000). This relates to the extent up to which the building function opens up towards the street domain or it is protected from the sidewalk traffic. To confirm the relation between building function and type of transition, the building use associated with each door was related via descriptive statistics to the type of threshold in terms of access (primary or secondary).

For the specific interests of this study a broad land use classification was used which essentially distinguishes between primary classes of uses: domestic, commercial, uses related to community services or facilities, and 'other' uses (such as offices, banks, hotels etc.). These use classes constitute degrees of regularity of private-public encounter. Looking at these basic classes by recording land uses behind every door entrance enables analysis to capture the degree of variance or uniformity of the street micromorphology in terms of probabilistic private-public encounter. This analysis was performed using a geographical information system (GIS), as mentioned earlier.

Overall, it is suggested that in order to form a basic reading of the socio-spatial profile of a street segment the following properties are essential: interface density, land use and syntax.

Encounters and architecture

Architecture is not only a means for building to fulfil function; it is also a means for culture to become embedded in built form – in terms of both aesthetic and social symbolism (see Chapter 3). Cultural ideals have themselves an impact on the building façade and the building-street interface in terms of density and immediacy examined here. To address the impact of varying *architectural styles* in the structure of interior-exterior encounters, the study includes descriptions and observations regarding the way architecture influences the micromorphology of the sidewalk. This discussion is mainly the output of empirical evidence – rather than analytical – which was compiled by gathering examples from the built environments in Islington and the West Village.

A special architectural element of the street interfaces in both terraced and row housing schemes is the stoop. This study considers stoops with wrought iron doors or very high elevation from the street level as secondary thresholds. On the other hand, stoops free from any boundary and with only few steps are considered as direct entrances, since the stoop area can be accessed for public use (in the common practice, for instance, of sitting on the stoop). Considering Newman's hierarchy of publicity to privacy (*Defensible Space*; 1972, *Community of Interest*; 1975), it could be said that in the first case stoops work as semi-private spaces, while in the second, as semi-public.

TABLE 2 Measures, descriptions and data	Case study	Unit of analysis	Data	Data source
Interface map	ISL, WV	Building	Building thresholds, threshold use, type of transition	Author’s survey and mapping
Door encounter rate	ISL, WV	Street side	Building thresholds, building façades length	Author’s survey and mapping
Block front length / Segment Length	ISL, WV	Street segment side	Building façades length, segment length	Author’s survey and mapping
Threshold frequency	ISL, WV	Street segment side	Building façades length, building thresholds	Author’s survey and mapping
Historical / Current Threshold frequency	ISL, WV	Street segment side	Building façades length, building thresholds	Author’s survey and mapping
Historical / Current Threshold frequency of direct thresholds	ISL, WV	Street segment side	Building façades length, building thresholds, type of transition	Author’s survey and mapping
Building types	ISL, WV	Building	Building types	Author’s survey and mapping
Mixing of uses	ISL, WV	Street segment	Building thresholds, threshold use per street segment	Author’s survey and mapping
Mixing of uses	ISL, WV	Building	Building thresholds, threshold use per building	Author’s survey and mapping
Historical land uses	ISL, WV	Building	Historical building uses	Islington: Data retrieved from Post Office Directories, c. 1852, 1895, 1915. The West Village: Data retrieved from *Bromley & Co. Fire Insurance Atlases* for c.1921 and 1955. Author’s mapping in ArcGIS

Historical street network	ISL, WV	Street segment	Historical street axial and segment maps	Author's mapping. Islington: Basemaps from *Ordnance Survey maps*, c.1910, 1965, 2013. The West Village: Basemaps from *Bromley & Co. Fire Insurance Atlases* for c.1891, 1921 and 1955; and from *Department of Information Technology and Telecommunications, NYC* for 2011.
Booth map	ISL	Street segment side	Booth's classification per segment side	Islington: Data retrieved from Charles Booth poverty map c.1898-9, courtesy of Prof Laura Vaughan, LSE and EPSRC. Author's mapping in ArcGIS.
Built form transformations	WV	Building	Comparison of building footprint, building types and building heights to classify buildings as demolished, altered or remaining	The West Village: Data retrieved from *Bromley & Co. Fire Insurance Atlases* for c.1921 and 1955. Author's mapping in ArcGIS.

Table 2. Measures, descriptions and data for Islington (ISL) and the West Village (WV).

4.3.3. Historical research

The second set of research inquiries aim to investigate the role of street network in distributing changes on the built form on the one hand, and the role of building form in assimilating those changes on the other hand. This query implies looking at the urban pasts both in terms of the street networks and built forms. To study urban transformations of the historical network, there was the need to compose *historical segment maps* of the London and Manhattan grids. To study built form change, it was considered necessary to conduct, firstly a building survey of current built form typological properties, and secondly, an archival research for retrieving information about the building past.

Historical street network maps

In order to perform historical street network analysis, the historical street axial and segment maps were composed with the method of cartographic redrawing (Serra and Pinho, 2011; Vaughan et al., 2013; Serra, 2014); the method suggests that the historical maps are drawn working on the basis of the most current map and going backwards in time-periods. By using as a basis the lines – namely, the streets' representations – of the most recent map, the lines of the preceding time period are redrawn (through removal, addition, or modification). The historical time periods analysed and compared for each case study vary depending on the available historical maps for the city grids. For London, *Ordnance Survey Maps* were used for the year c.1910 and 1965. For Manhattan, the *Bromley & Co. Fire Insurance Atlases* for c.1981, 1921 and 1955 were used as background maps for composing the historical space syntax maps.

Building type survey maps

The survey of buildings focused on recording the presence of the studied historical building types in the current streetscape; namely, *terraced houses* in Islington and *row houses* in Manhattan. In each case, any other significant housing typologies were also recorded. More particularly, in London the building survey included, aside from the record of terraced houses, the mapping of *council (i.e. social) housing buildings*, as well as of the few *villas* which still survive in the case study area. In the West Village, the survey mapped alongside row houses their descendants: the *old*- and *new-law tenements*.

Diachronic comparisons

The historical research performed for each case study varies depending on a series of factors; most notably on data availability and the idiosyncrasy of each case study. The study had to adjust historical explorations to these factors. Thus, while analysis for the physical and spatial context follows more or less the same sequence in both Islington and the West Village, the discussions regarding patterns of urban change in each case present some differences in their approaches (the last sections of the two relevant analytical chapters – Chapter 5B and 6B).

In Islington historical research uses the maps and notebooks of Charles Booth to relate the socio-economic past of Islington with the area's development over time. Analysis discusses with the use of descriptive statistics whether street sections which have been classified in poor condition by Booth present differences in comparison to parts which received better classification: firstly, in terms of syntactical properties looking at street configuration diachronically, and secondly in terms of the micromorphology of the street interface.

Furthermore, in the case of Islington detailed historical land use description was gathered for a single street section within the area to discuss the flexibility and adaptation of the terraced house in shifting building uses over time. For this purpose, the London *Post Office Commercial and Professional Directories* c.1852, 1895 and 1915 were examined in relation to Ordnance Survey historical maps c.1871, 1894 and 1914.

In the West Village, a more detailed historical research was performed for the whole area. Quantitative data were extracted from the *Bromley & Co. Fire Insurance Atlases* for c.1921 and 1955 regarding building uses and building change (demolition or alteration). These data were manually imported in the ArcGIS geographical information system to then be related to the street network historical properties in terms of street configuration. The method used is very similar to the one extensively described by Serra (2014) for performing 'diachronic axial analysis'. Serra applies the method to *axial lines*, looking at *grid transformations*. The study here applies diachronic analysis to look at *built form transformations* and the object studied is the *building*. Buildings are marked based on whether they were demolished or altered on continued from one time-period to the next. Diachronic analysis at the building scale is in line both with the general assertion of this thesis which develops methods for the study of micromorphology, as well as it is significant for understanding whether/how building morphology can work probabilistically over time. Here again, with the use of descriptive statistics the relation between street network and built form change was examined.

Finally, while in Islington analysis zooms in at the block scale to discuss the terraced house flexibility in functional adaptations, in the case of the row house analysis looks at the building scale and the building interior to discuss in greater detail how flexibility is supported by the floor plan layout.

Conservation areas

Districts in both case studies became designated as conservation areas. Designation started for both Islington and the West Village in 1969, with additional areas designated over time thereafter. This presents twofold interest for the study: firstly it becomes of interest to examine the properties of the street network diachronically in districts where historical buildings have survived longer in comparison to the properties of street sections which fall outside the conservation areas; and secondly, to examine whether the districts with greater presence of historical built form present a different street interface micromorphology. Descriptive statistics bring together historical data regarding syntax, building morphology and land use land uses in a comparative presentation for conservation and non-conservation areas in both case studies.

4.4. Limitations

Actual v. virtual street activity

The first limitation of this research refers to the distinction between the actual street activity patterns and the virtual ones studied here. The thesis here does not compose an observational study of encounter and sociability; rather it uses as its analytical departure the configurational and morphological potentials for encounter and co-presence as these are generically defined by spatial patterns and building morphology *per se*. The study does not measure the actual use of space and social activity at the street domain, but the probabilistic field of the virtual community.

This limitation is also related to the fact that the study focuses on a configurational analysis of the street interface micromorphology. Analysis centers on encounters and co-presence at the ground floor level, and looks at probabilistic interior-exterior encounters specifically in terms of density and immediacy relations. In other words, the architectural and cultural implications of the three-dimensional architecture of the street interface are not considered in the analysis, except for when these might impact on the *frequency* and *type* of the interior-exterior transition. However, at same time that this consists a methodological limitation, it is also the thesis's strength – considering the discussion by Peponis (1989), mentioned earlier in the introduction, who argued that the abstract complexities of architecture need to be addressed at a generic level, and beyond any geometrical, aesthetical and cultural dimensions in order to meaningfully inform design regarding the impact of urban form on a city's social ordering (Hillier, 1989).

Similarly, the land uses are broadly grouped reflecting a basic gradient from the public domain to the private – namely reflecting basic variations in accessibility relations and the immediacy between the street and the building interior.

Planning controls, zoning and regulations

An important factor that affects the formation of the built environment, and is not thoroughly discussed by the analysis presented here, is the effect of planning regulations on urban form. Without a doubt, land controls, zoning and building codes regulate and manage a city's development and the shaping of its structural urban elements (c.f. Burgess, 1994; Ben-Joseph and Szold, 2004; Carmona et al., 2006). Emily Talen (2012) explains that city rules affect different scales of urbanism (from buildings to regions) as well as different properties of the cityscape. Talen emphasises in particular those aspects of city rules related to urban pattern, use and form (*ibid*., p.17). In turn, pattern relates to subdivision rules and the two-dimensional organisation of plots and streets; use relates to land controls and building function; and form to the three-dimensional properties of buildings. The complexities and the impact of city rules on urban morphology can be direct or indirect and of small or large scale – for instance, fire codes may impact on street width (consider the case of London after the Great Fire in 1666), on building materials, and in turn on building structure, or specify the distance between stairs and therefore the building façade width. Street width has other counter effects – to name an example, street width consists a factor that determines restrictions on building heights to secure light and ventilation on sidewalks (c.f. Knowles and Pitt, 1972; Muthesius, 1982; Girouard, 1985).

In both London and New York, city rules have affected the street pattern, the building form and function, as well as the distribution and mixing of uses in various districts within the city. The seventeenth century London was regulated by a system that classified streets determining their width and the building heights (Baer, 2007) and this classification is obvious in the Rebuilding Act of 1667 as well (Davis, 2006). In general, building regulations in both cities aimed to address the problems of the growing urbanities by controlling the increasing population densities and dealing with issues of light, fresh air, public hygiene and safety. For the case of London, the Rebuilding Act of 1667 after the Great Fire, the Metropolitan Building Act of 1844 and the London Building Act of 1894 were fundamental regulation schemes that shaped the two and three-dimensional city form. In New York, building regulations of importance have been the Tenement House Acts which aimed in controlling the poor living conditions and overcrowding in the tenement buildings (The First Tenement House Act of 1867, The Second Tenement House Act of 1879 and The New York State Tenement House Act of 1901; see Plunz, 1999).

Talen (2012, p.21) suggests that *'[n]o rule-making approach has had more impact than zoning'*. Zoning differs from building codes both in the scale of application and in its intention: while building laws are applied in a uniform way across all city parts, zoning aims to take into account of the varying city sections and to treat them differently in terms of densities, building heights and uses, so that different places are governed by different rules. Zoning organises and separates not only functions, but social groups as well. However, prior to ideas and ideals of social engineering that favoured functional and social separation, zoning was mostly a fit-for-purpose planning tool for the distinct sections of urban space. Notably, Talen notes that the New York Zoning Act of 1916 *'essentially codified existing land uses'* (*ibid.*, p.104).

Considering that the topic of building and planning regulations is vastly complex and multi-scalar, the study here frames the inquiry of research with the limitation of looking at the properties of built form *per se* which relate to formation of the virtual community – namely those properties that affect the syntax of probabilistic virtual encounters at the street domain. The studied urban configurations are treated as the product of both planned and emergent urban processes, but are examined specifically in terms of their morphological and configurational properties and of the way these building complexes perform over time under shifting spatial, cultural and functional circumstances. While the morphological and functional properties of the current urban streetscape have been shaped by the various planning controls, zoning and building regulations, the main inquiry here was to trace where does change in built form occur within the urban grid; whether built form change has any relation with the properties of the street network; and how do the varying patterns of built form change affect the streetscape in terms of potential building-street encounters. Namely, the inquiry has not been to examine how change is regulated, but how different syntaxes of similar urban morphologies (such as the terraced and the row housing schemes) respond to issues of continuity and change over time and under varying challenges. Similarly, at the building scale, the building codes mentioned earlier have had an impact on the building layout and design parameters of terraced houses in London and row houses in Manhattan. However, the main focus of this study is the historical built form transformation of the terraced and row house micromorphology in terms of the building-street relation. The point of interest for the purposes of this study refers to the morphological properties of these historical building types that allowed for a complex micro-morphology to develop over time. It should be mentioned that both case study areas examined here, Islington and West Village, include conservation areas. Again, the regulations and codes guiding urban conservation are not discussed in detail by the thesis. What is of interest is the effect of these policies on the type of streetscape that these conservation districts present nowadays in terms of the generated street activity and of probabilistic encounters.

Time and data limitations

Another methodological limitation refers to the properties of the historical street interface in terms of building thresholds. These are not based an actual survey of historical building thresholds. A hypothetical measure is used, which is however defined based on the morphological particularities of each studied historical urban settlement. The final limitation refers to the potential difficulties in the application of the tools and methods suggested here for future research. The data collection for this research has been very demanding and time-consuming since it zooms in at the micromorphology of the street interface, yet the analysis extends to cover an entire urban area.

In what follows, analytical examination and descriptions open with the case of Islington. Afterwards, the explorations visit the West Village, to then bring the two case studies together in a comparative consideration of the main research inquiries and results.

5A

Chapter five - Islington, London

(Part A)

5.1. Introduction

With this chapter begins the analytical exploration of the micromorphology of the street interface, looking at the streets at the heart of Islington, London. The chapter is divided in two parts. The first part examines the structure of the street interface in terms of the virtual community, namely in terms of probabilistic encounters at the street domain. Encounters are discussed in relation to the street network properties and built form properties. The second part (5B) studies the streetscape in terms of historical building typologies and discusses processes by which urban change impacts on the *spatial*, *physical* and *social* functioning of the streetscape over time.

In the following paragraphs of Chapter 5A, Islington is introduced via a brief account of its history in Section 5.2. Next, the present streetscape is described: the discussion refers firstly to the spatial and socio-economic structure of the case study area, and secondly to the properties of the building-street interface. Aiming to decode the role of *street configuration* and *built form organisation* in configuring varying urban situations, the analysis presents an investigation into the properties of the current streetscape. The approach combines the syntactical (space syntax) and morphological (urban form) techniques of analysing urban space.

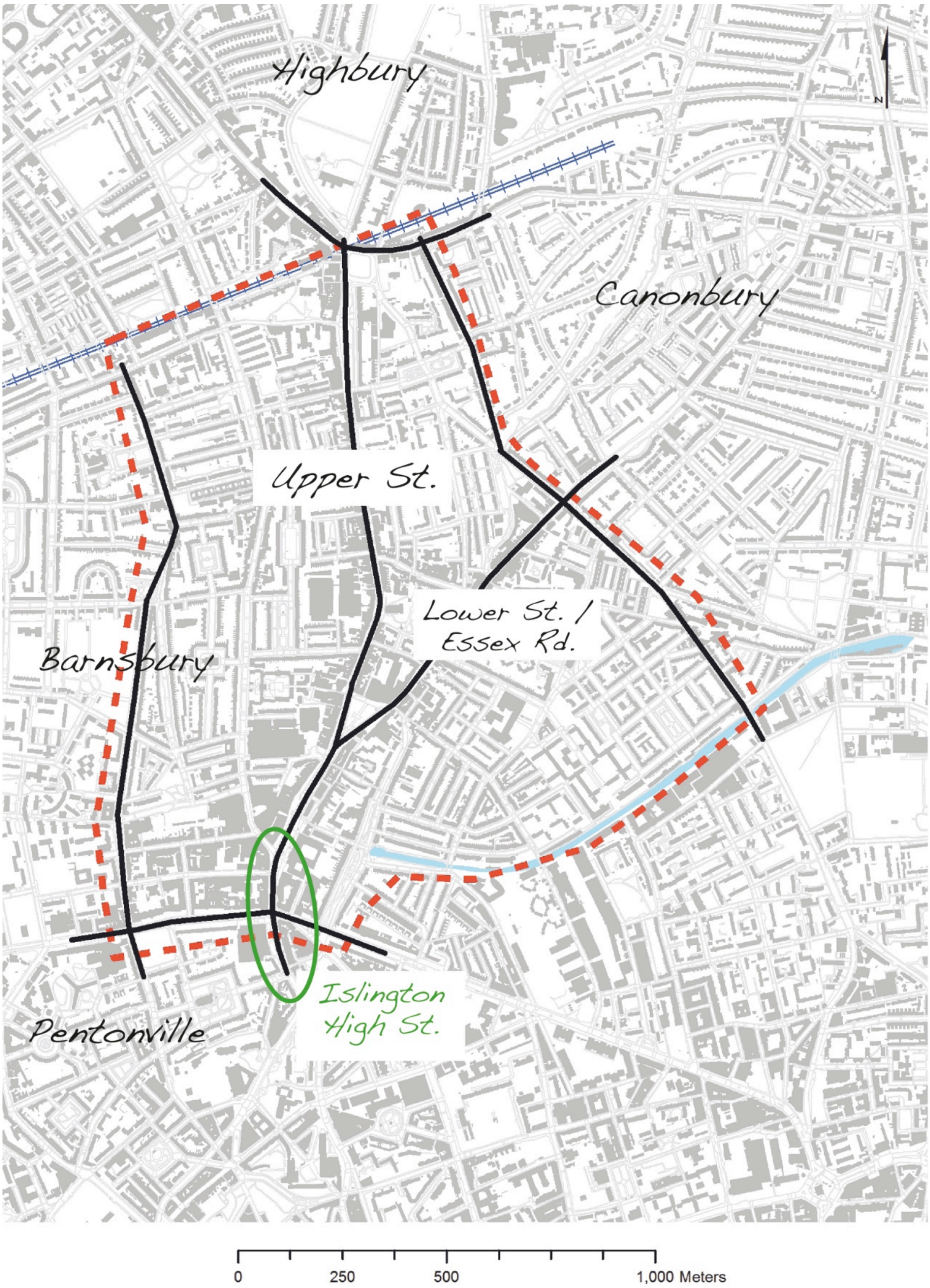


Figure 26. Islington, London: case study area.

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

5.2. History

Islington has a history of rapid development and of shifting social context over time. Known in the mid-sixteenth century for its inns (watering-holes for long-distance travellers), the area started its first phase of development as a dormitory village. It soon became known as an area of suburban retreat, attracting rich and eminent residents due to its proximity to the cities of London and Westminster. By 1590, the main building development in the area had started to extend across the alignment of the main road later known as Islington High Street (Figure 26). This rather short street has historically held a significant position for journeys towards and from London, connecting travellers' routes active since the Middle Ages: Liverpool Road and Upper Street with St John Street and Goswell Road. At its northern extension, Islington High Street turns into Upper Street (the eastern branch). A little further north, at the site of Islington Green park, Upper Street meets Lower Street (later called Essex Road). Upper and Lower Streets are, historically and today, the two main roads of the area.

Since the years of the English Renaissance, Islington's proximity to the City of London has had an impact on the area's development and growth. Between the mid-seventeenth and mid-eighteenth centuries, London's edge had reached nearby Sadler's Wells, Finsbury Fields and Hoxton (Inwood, 1998, p.258). In the eighteenth century the appeal of suburban living to the middle-classes was flourishing as an escape sought from metropolitan overcrowding (*ibid.*, p.570-571). Rows of terraces started to spread along the main roads: the western side of Upper Street, Lower Street, and the area between the two streets (until they meet Cross Street), had all developed along the main street frontages. Islington was becoming one of London's satellite towns (Baker, 1985; McKellar, 1999) (see Figure 27).

Within the first three decades of nineteenth century, the population in Islington almost quadrupled, from 10,000 to 37,000. Small villas and terraces started to dominate the sites of Canonbury and Barsbury (see Figure 26), as well as the sides of Liverpool Road (Inwood, 1998, p.582). Inwood highlights that *'[o]f all London's satellites, the modest roadside town of Islington was the most vulnerable to suburban encroachment.'* As London continued to expand towards its fringes, Islington's suburban qualities were very soon to be infused with the city's urban growth. Inwood explains that *'[t]he resulting mixture of town and country, or rus in urbe, as Victorians liked to call it, had a particular appeal to middle-class Londoners.'* (*ibid.*, p.570)

Growth in the nineteenth century mainly took the form of redevelopment and changes in building use, as Islington transformed from rural town to urban density.

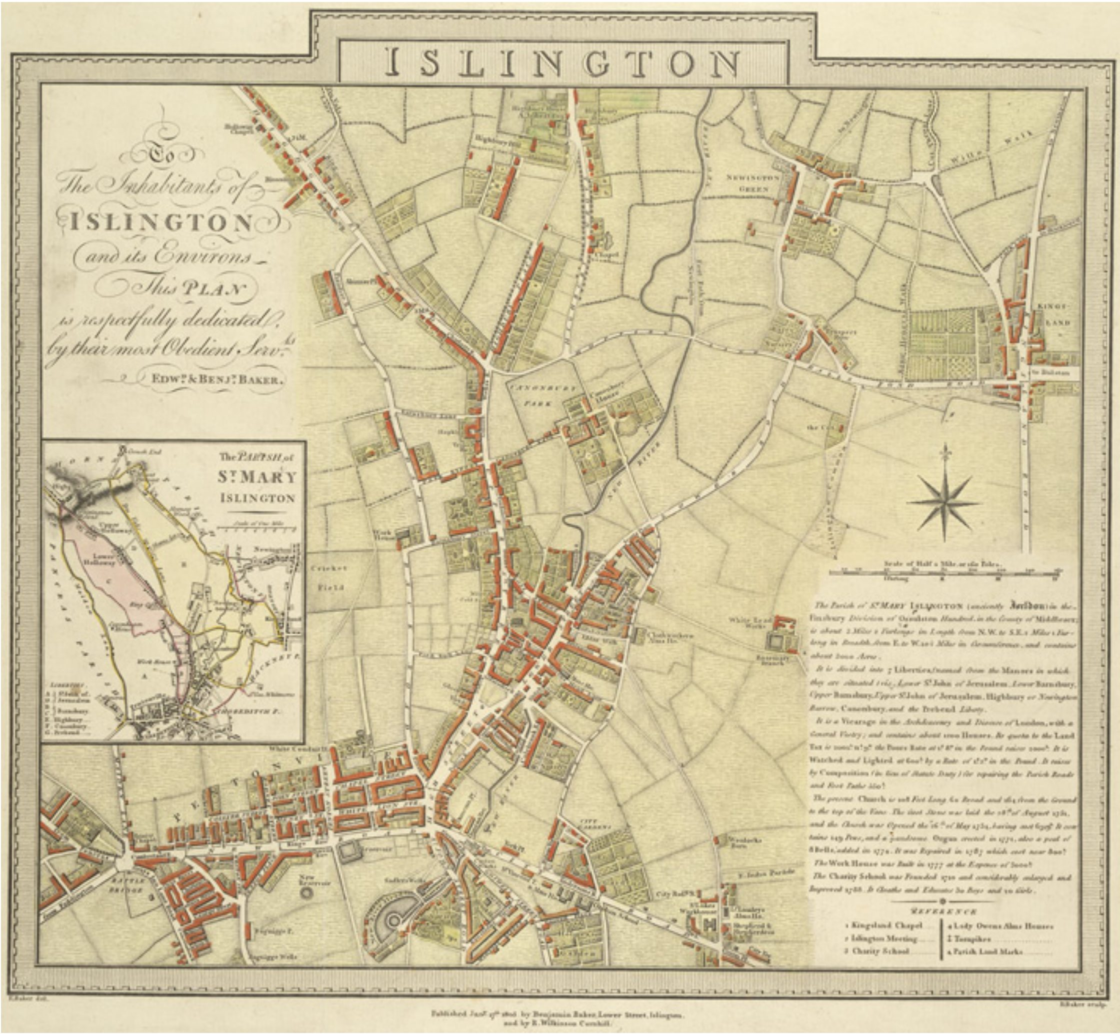


Figure 27. Islington, London, c.1805.

A plan of Islington and its environs, originally published in 1805 by E. Baker (available via Wikimedia Commons).

The shifting social image

Between 1841 and 1861, Islington's social image experienced a radical change as the area underwent its most active period of development, resulting in a massive spread of terraced housing. The parish saw a near tenfold increase in population from 37,316 in 1831 to 335,238 in 1901 – the highest numbers for any other borough in southern England or even for towns (today cities) including Belfast, Newcastle and Edinburgh.

This time the waves of urban migration brought into Islington those in the lower brackets of the middle-class, artisans, and the working classes.

At that time many of the middle-class single-family terraces in the Barnsbury area of Islington were subdivided into multi-dwellings.[22] Commercial premises increased in number to serve a rapidly rising population of settlers. Many of the older houses in Lower Street were replaced by rows of shops, while Upper Street and Essex Road were already established as the primary thoroughfares.[23] The continuously increasing influx of settlers led to overcrowding and a decay of living conditions. By the mid-nineteenth century the image of Islington as a desirable suburb had been overturned. The population was now mainly poor and the need for working-class housing provision was becoming imperative. Severe deterioration of housing conditions affected mainly the oldest street parts of the area[24] (primarily, those houses clustered behind the shop alignments of High St, Upper St and Essex Rd), rather than the latterly developed districts of Canonbury and Barnsbury, which dated from the turn of 19th century. Instead, in the case of these latter districts, housing spread gradually, allowing the formation of a network of residential garden squares (Figure 28).

Overall, Islington's growth follows the typical pattern seen in London's urban places, with the high street acting as the core of local social life (Vaughan et al., 2013; Dhanani and Vaughan, 2013; Bolton and Vaughan, 2014). The area around Upper Street developed along the lines of a spatial discipline which distinguishes the residential background activities from the more actively 'urban' foreground. The distinct role of Upper Street as the local socio-economic core, along with its prosperity, was maintained even during the years of the wider area's decline[25] (Figure 29). The widening of Upper Street at the end of the nineteenth century indicated the street's ongoing importance. The street continues to play a role today in evening entertainment for a relatively wide area of London, with theatres, cinemas and many restaurants in addition to its commercial and retail activities.

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[22] Old Ordnance Survey Maps, Clerkenwell, King's Cross & The Angel, The Godfrey Edition, c.1871.

[23] Old Ordnance Survey Maps, Highbury & Islington, The Godfrey Edition, c.1871, 1894 and 1914.

[24] See the Old Ordnance Survey Maps, Clerkenwell, King's Cross & The Angel, The Godfrey Edition, c.1871; it is explained that deterioration was often the result of leasehold arrangements which did not prevent building at the back of the main roads.

[25] *British History Online*, Islington growth. [e-source, available at: < http://www.british-history.ac.uk/report.aspx?compid=6734&strquery=islington >]

Figure 28. Islington, London: network of garden squares.

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

Figure 29. Charles Booth poverty map: Islington, London, c.1898-9.

© Courtesy of Prof Laura Vaughan, LSE and EPSRC.
http://booth.lse.ac.uk/

During the twentieth century many districts of Islington were subject to major change with a marked impact on the districts' prevailing built form. These transformations reached their peaks after both world wars. Rebuilding and rehabilitation projects occurred mainly around the areas off Islington High Street and Essex Road. Not long after these major urban transformations, Islington Council took action in the opposite direction as well: that of the protection and preservation of the historical built form. Since 1969, conservation areas in the surroundings of Upper Street were designated and specific guidelines stipulated governing future architectural practice and land use within urban districts of historical significance in Islington.

From its rise as a suburban retreat to its radical urban growth, its subsequent urban transformation and the conservation of its historical buildings, Islington encompasses distinct street profiles with a diverse socio-spatial character, ranging from areas with almost exclusively domestic streets to those carrying a distinctly non-domestic urban buzz. Throughout their urban history, the streets of Islington have been predominantly occupied by long-standing terraces which are found to support all these diverse qualities of urban life. Whether designed for different social classes – and therefore displaying a lesser or greater degree of architectural modesty, whether built for single or multiple occupancy, and whether converted for commercial, residential or mixed-use, terraced houses dress up the Islington streetscape, either in their original historical appearance or after having undergone frequent built-form alterations.

5.3. A reading of the streetscape

This section aims to understand a street's socio-spatial profile by examining encounter and co-presence patterns likely to take place in the street domain. More particularly, the aim here is to explore the potential role of street network properties on the one hand and built form properties on the other in the probabilistic activity generated at street level. This study looks at the present profile of the area around Islington's historical thoroughfare in terms of:

- *street layout;*
- *land uses* and socio-economic functions taking place in different districts of the area; and
- *building-street interfaces* and their associated probabilistic interior-exterior relations (private-public encounters).

5.3.1. Street layout

This study focuses on the part of Islington surrounding Upper Street (see Figure 30; study area highlighted in light blue), with the case study area covering approximately 1.45km^2. In terms of the area's street network, this is comprised of 643 segments with a total segment length of 37.7km. In order to avoid any edge effects in syntactical calculations – as suggested by Dhanani and Vaughan, 2013 – the boundaries of the studied street segment map extend approximately 3km around the case study area (reaching to 146,333 segments in total, with total a segment length of 8,194km). The mean segment length for the study area (58.6m) is quite similar to the mean segment length for the extended map (56m). More specifically, almost half of the studied area around Upper Street (49.8%) is comprised of short segments with a length up to 50m. This can be expected as an outcome of the irregular morphology of the street layout of London.

Figure 30. Islington, London – Nolli map showing streets in black; the case study area and surroundings.

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

Most of the remaining segments are between 50-100m long (37.3%); few fall within the range of 100-150m. Finally, just 4% of the segments are between 100-250m long. These longer lines are essentially a morphological testament to the area's historical street layout. The aim of developers in the area – particularly in the fields of Barnsbury – was to create a suburban destination attractive to the middle classes, with long street views of single-family terraces. Alan Godfrey, in his edition of the *Highbury & Islington 1894 Ordnance Survey Map*, recalls a poem of 1827:

> *'You who are anxious for a country seat*
> *Pure air, green meadows and suburban views;*
> *Rooms snug light – not overlarge but neat,*
> *And gardens water'd with refreshing dews,*
> *May find a spot adapted to your taste,*
> *Near Barnsbury park, or rather Barnsbury Town…'*

The historical syntactical maps used for the analysis of the street network were drawn on ArcGIS software based on Ordnance Survey Maps for c.1910, 1965 and 2013. The method used for drawing these maps follows the principles of 'cartographic redrawing', (as introduced by Pinho and Oliveira in 2009; Serra and Pinho, 2011).

Figure 31 shows these maps together in order to provide a comparative overview of the area's growth within the surrounding London grid. The figure illustrates the grid transformations (marked in red) between the three time periods studied. These maps highlight the overall densification of the grid pattern over time; note the significant number of grid transformations marked in red. Figure 32 shows the syntactical measure of the *combined integration and choice* for each time period. It seems that an overall effect of urbanisation processes is that warmer colours[26] on the syntactical maps (red-orange-yellow colour range) – which signify higher space syntax values – appear to cover a larger network area over time. To explain this further, looking at the maps of *combined integration and choice* we can form an idea of the street layout structure in terms of *accessibility* and *permeability*. The measure is calculated for radius 2500 meters. On the maps it is shown that the case study area 'sits' on the

[26] The maps are coloured in ArcGIS, based on a classification of syntactical values in 30 bands from high (red) to low (blue). The syntactical calculations are performed in Depthmap software.

c.1910

c.1965

c.2013

Figure 31. Islington, London – grid transformations.

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

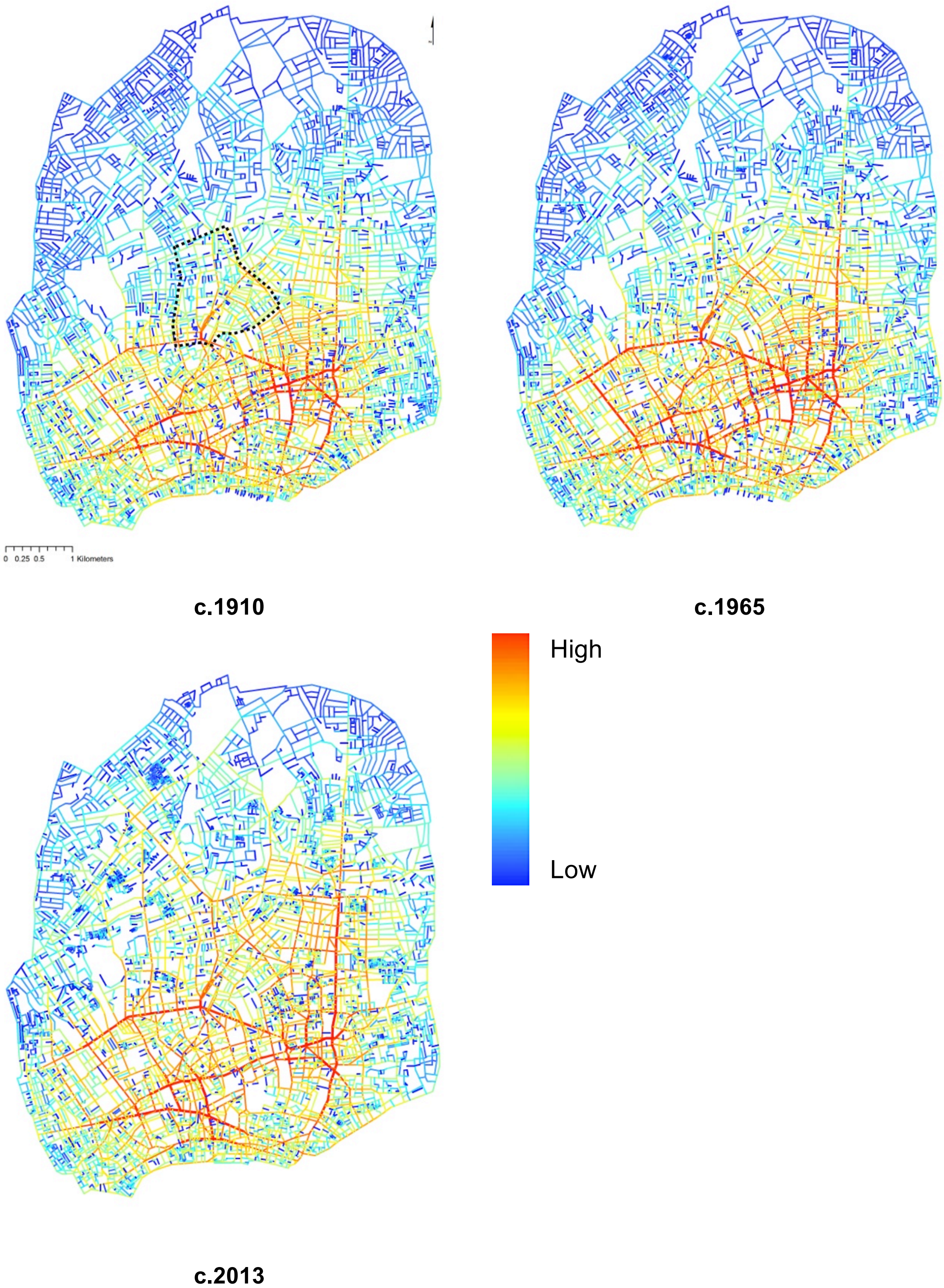


Figure 32. Islington, London – historical street network.

Showing segment angular analysis for the measure of *combined integration and choice*, for radius 2500 meters.

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

historically well-connected long arteries of the Euston-Pentonville-City Roads[27] that join the eastern districts of London with the city centre. This means that on the one hand Islington High Street is an important junction within its wider surroundings. On the other hand, the long 'red' lines of the (1) Euston-Pentonville-City roads and (2) Oxford St-Holborn High streets pull the core of the wider network southwards, assigning a relatively more local profile to Upper Street. Still, when moving through the case study area, the importance of Upper and Essex streets is clear. Tables 3, 4 and 5 show the historical significance of both streets for the case study area. The table summarises the mean values for the *combined measure of integration and choice*, for different radii and across time.

Syntactical calculations based on the combined measures of integration and choice are relevant when aiming to understand the relational properties generated by the spatial configuration of an individual street system. However, as previously mentioned in the methodological approach, the measure does not allow for numeric comparison between different systems; this is caused by an effect on the calculations which derives from the different sizes of the compared systems (or in syntactical terms, different *depths*). In their 2012 publication 'Normalising least angle choice in Depthmap', Hillier et al. explained how this problem can be overcome and introduced the measures of *normalised choice* and *normalised integration.* Based on the authors' interpretations, the values of *normalised choice* that stand above the threshold of 1.4 reveal the structure of the street network.[28] Figure 33 shows the results for *normalised choice* when calculated for the city-wide properties of each segment map (radius n). The values above the threshold of 1.4 are marked in thicker red lines to visually clarify the organisation of the street layout. Comparing the three maps, it is observed that there are shifts in the way the network in each time period is connected up. On the east, the long, almost straight line of Kingsland Road, which then turns into Stoke Newington High Street, has established over time a role in the foreground structure of the grid. At the centre and west side, the spatial situation appears less stable, with shifts in the importance of Essex and Caledonian roads, while at the same time the

[27] New Road opened in 1756-7 (today the Marylebone, Euston, Pentonville and City Roads altogether) (Inwood, p.260). In the Old Ordnance Survey Maps, Clerkenwell, King's Cross & The Angel, The Godfrey Edition, c.1871, it is mentioned that the New Road worked as *'arbitrary boundary of inner and outer London'*.

[28] *'Experience so far suggests that 1.5 (segments having a value of 1.5 or more) and 1.4 are the most interesting and informative systems: 1.5 identifies a dominant global structure, and 1.4 extends this to how it is related to more local organisation'* (Hillier et al., 2012, p.180).

TABLE 3 c.1910	INT_CH R800	INT_CH R1000	INT_CH R1600	INT_CH R2000	INT_CH R2500	INT_CH Rn
Case study area	512.84	773.47	1855.54	2788.53	4106.30	12100.62
Upper St	720.15	1121.23	2922.67	4514.54	6590.29	20292.66
Essex Rd	1007.37	1377.50	3401.39	5215.80	7743.06	22857.10

Table 3. Islington, London – main streets and network properties. (c.1910)

TABLE 4 c.1965	INT_CH R800	INT_CH R1000	INT_CH R1600	INT_CH R2000	INT_CH R2500	INT_CH Rn
Case study area	505.52	762.18	1803.01	2669.61	3898.74	11288.44
Upper St	785.51	1208.16	2955.16	4506.97	6563.84	19508.05
Essex Rd	950.40	1326.47	3299.68	5040.01	7483.75	22064.93

Table 4. Islington, London – main streets and network properties. (c.1965)

TABLE 5 c.2013	INT_CH R800	INT_CH R1000	INT_CH R1600	INT_CH R2000	INT_CH R2500	INT_CH Rn
Case study area	423.24	640.46	1527.76	2300.20	3443.34	10599.71
Upper St	694.22	1043.27	2452.14	3770.29	5840.70	18981.65
Essex Rd	793.25	1113.24	2633.84	4199.14	6115.45	18752.71

Table 5. Islington, London – main streets and network properties. (c.2013)

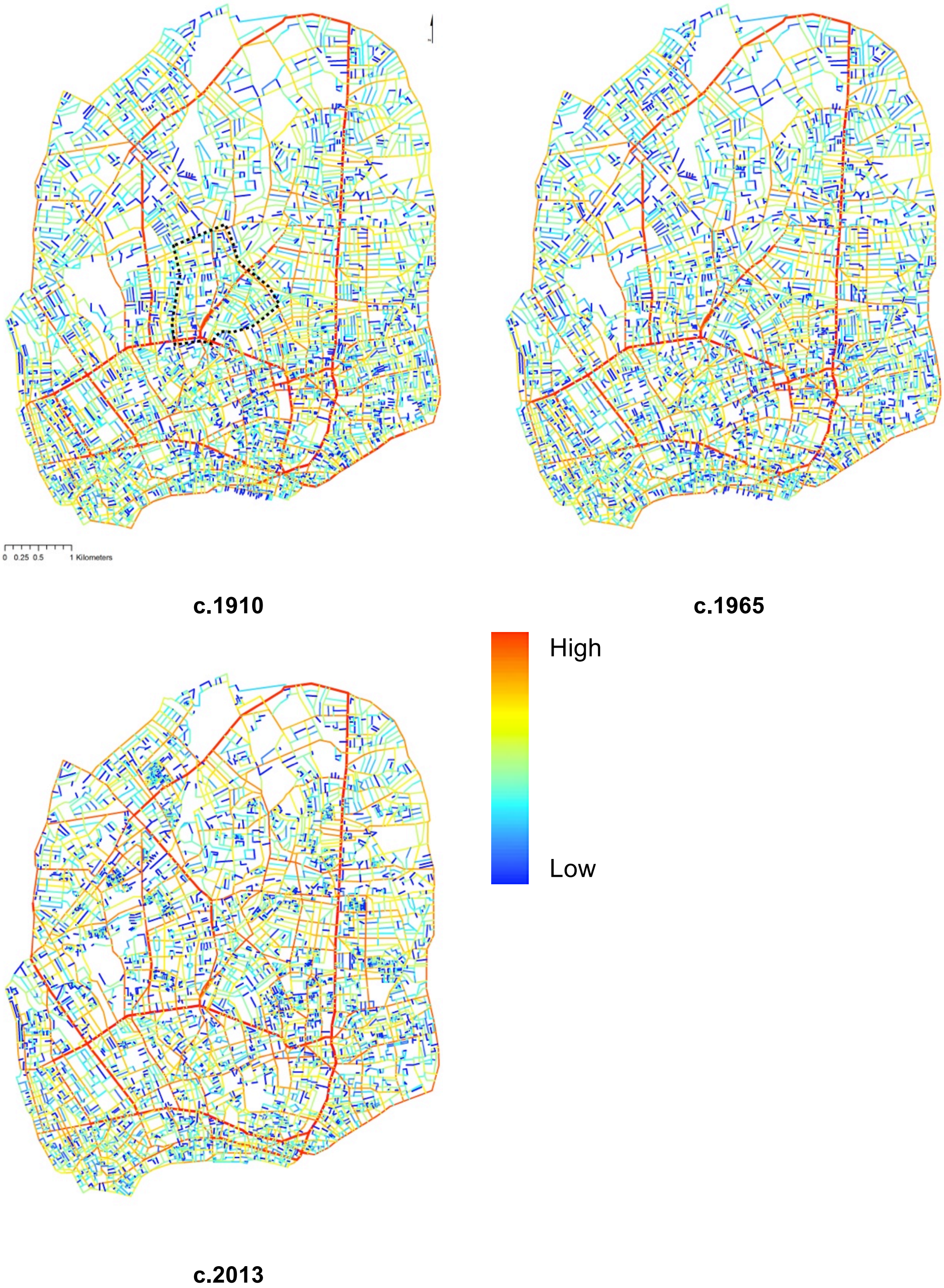


Figure 33. Islington, London – historical street network.

Showing segment angular analysis for the measure of *normalised choice*, for radius n.

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

connection to Camden Town improves. Regarding the area around Upper Street, it is interesting to note that in the c.1910 and c.1965 maps Essex Road is picked up as part of the foreground network; indeed, although in the very early years Upper Street formed the primary artery for trade and entertainment, the development of Essex Road as an equally important commercial route is evident in the street's current image. Upper Street, however, presents a steadily important role for the area (see Table 6 for a comparison of the mean normalised choice values across time). Also, in the c.2013 map, the spatial importance of the historical thoroughfare appears to increase, with high syntactical values (red) for the northern and southern ends of Upper Street.

TABLE 6 Normalised choice (NACH) Rn	**c.1910**	**c.1965**	**c.2013**
Case study area	0.93	0.91	0.88
Upper St	1.38	1.38	1.38
Essex Rd	1.48	1.48	1.37

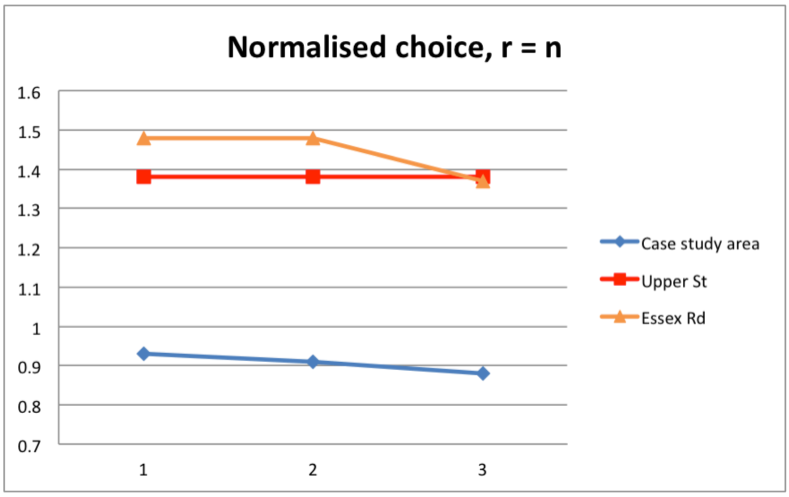


Table 6. Islington, London – main streets and historical network properties for the measure of *normalised choice*, radius n.

Having formed a general idea of the way the case study area is situated within its wider city surroundings, the discussion zooms in on the local context. The following analysis looks at the function and morphology of the present streetscape at the level of the ground floor. It examines whether there is any relation between the building properties alongside a street segment and the location of this segment within the street network. The aim is to explore the role of *street configuratio*n, *function* and *building morphology* in supporting varying street profiles and degrees of dense and diverse street activity. This exploration begins with the study of land uses (function) and their relation to the street network properties (street configuration). Following that, the discussion focuses on the properties of the varying building-street interfaces (building morphology) across the study area.

5.3.2. Land uses

Figure 34 illustrates the allocation of land uses in the case study area for c.2013. The recorded data have been collected by the author through a survey of the case study streets. The map shows the associated land use for each mapped building threshold. A *threshold* symbolises here a potential encounter between the building and street domains. For the purpose of this study, land uses are broadly classified as domestic uses (thresholds marked with grey colour), commercial uses (red colour), community services (light blue) and 'other'[29] uses (dark blue).

The building thresholds map provides a basic reading of the socio-economic profile of the studied area. The long commercial lines (red) of Islington High Street and its northern extensions, Upper Street and Essex Road, are highlighted. The spread and almost exclusive dominance of non-domestic uses in the area of Chapel Market (east of Islington High Street) is also noticeable. In other words, looking at the allocation of domestic and non-domestic uses we see an organisational logic: the linear strong socio-economic presence of the High Street and its branches (Upper St and Essex Rd), as well as a clustering of domestic uses in the internal sections of the case study area. This pattern appears to follow the area's spatial organisation in terms of the streets' importance within the network (see previous section, Tables 3, 4, 5 and 6). Considering that the remaining non-domestic uses also appear to cluster on well-connected street segments, or one step away from them, it becomes of interest to explore further whether the allocation of uses follows a spatially generated logic.

[29] *Other* uses refer to offices, banks, light industry, hotels etc.

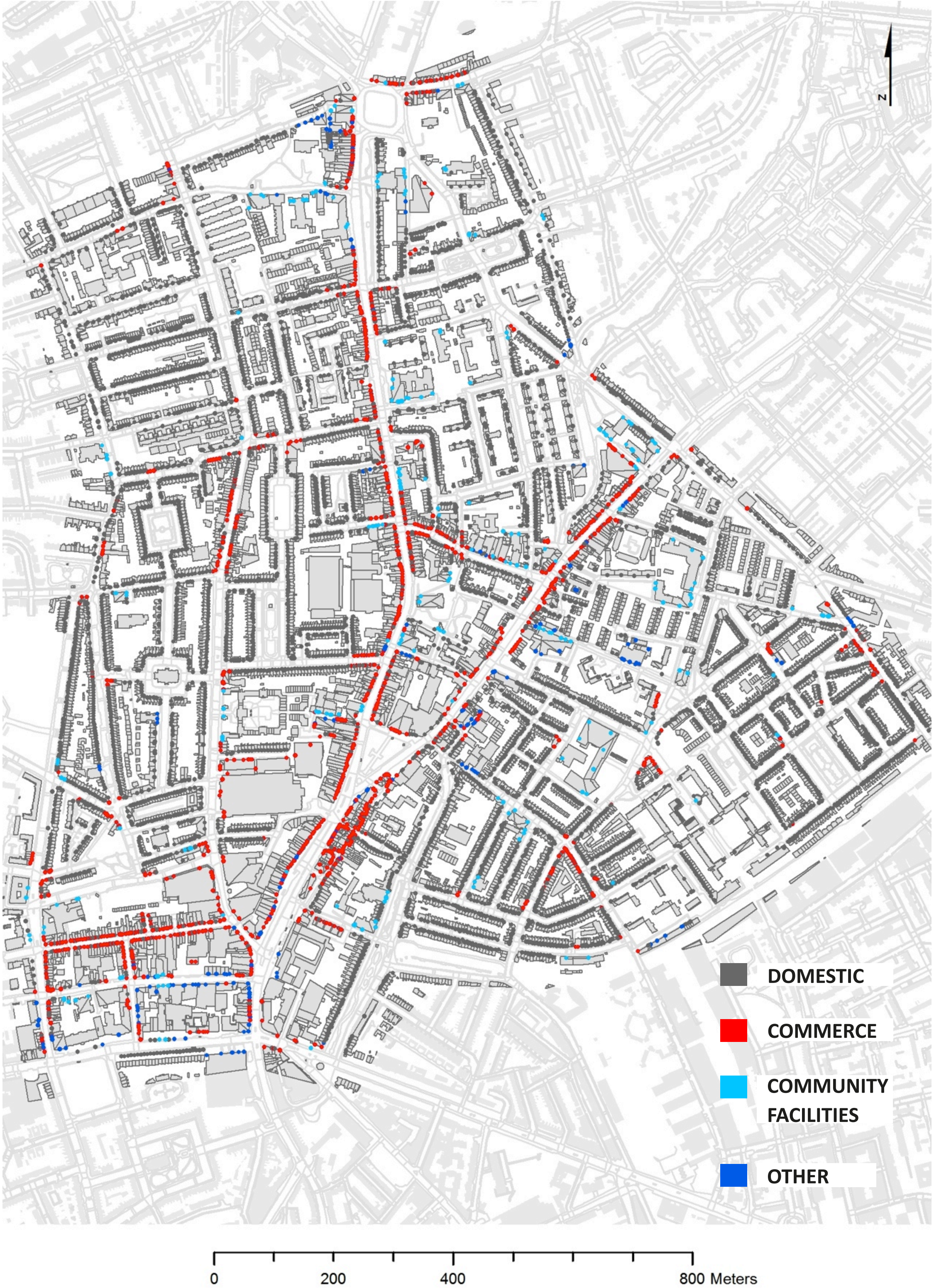
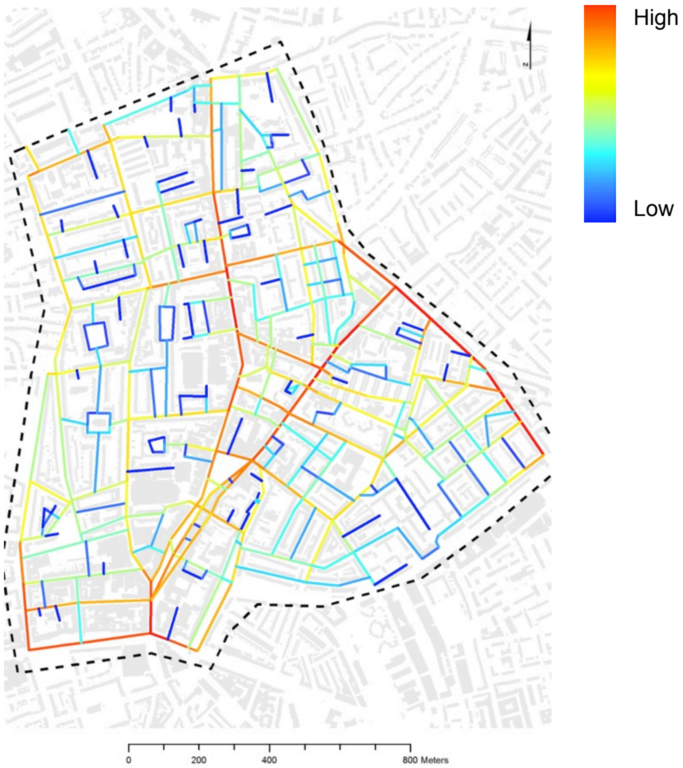
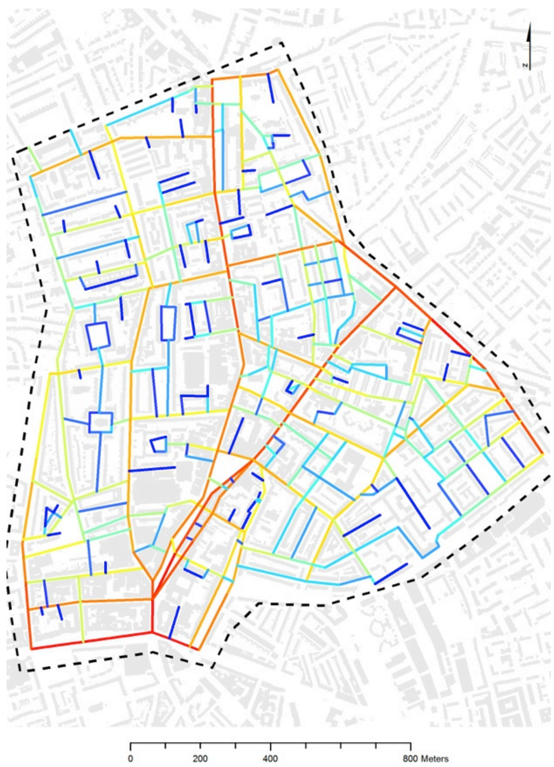


Figure 34. Islington, London – building thresholds and land use. (c.2013)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.



radius 800 meters



radius 2500 meters

Figure 35. Islington, London – segment angular analysis for the measure of *combined integration and choice.* (c.2013)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

To test further the potential relation of land use allocation with the properties of the street network, a different analytical approach towards the survey data must be employed. This time, based on the grid properties, street segments are sorted according to syntactical values (see Figure 35). Starting from the highest values to the lowest, segments are classified in three even bands: those with (1) *high* syntactical values, with (2) *middle* values and with (3) *low* values. Then, each group is examined in terms of building entrances and land uses facing the street segments. Here the test is applied for the measure of *combined integration and choice*. As mentioned previously, the combined measure of *integration* and *choice* considers accordingly a segment's potential for both *to* and *through* movement. In other words, it estimates the potential for a street part to attract movement – either as a *destination* or as a *passing through route* – when considering a city's pedestrian network. Analysis is performed for a walkable scale around the area (radius 800 meters), as well as for the wider surrounding city context (radius 2500 meters).

Results from this analysis are summarised in Tables 7 and 8. The percentages of domestic and non-domestic land uses for segments with high, middle and low syntactical values confirm a relationship between street configuration and land use allocation. For segments with high values in *combined integration and choice* the presence of non-domestic uses is significantly higher (40.4%) than for segments with low values (7.3%). More particularly, it is observed that commercial activities are nearly ten times more concentrated in segments with higher syntactical values (30.8%) than in those segments with low syntactical values (3.7%). In the case of Islington commercial activities are significantly more likely to be found in segments with a higher potential for pedestrian traffic. These results are in line with the extensive amount of space syntax research indicating the correlation between high pedestrian traffic levels and commercial activity (summarised in Hillier and Vaughan, 2007).

TABLE 7 INT_CH R800	**Façades**	**Doors**	**Domestic**		**Commercial**		**Community**		**Other**	
High values	1625	2292	1358	59.2%	712	31.1%	99	4.3%	123	5.4%
Middle values	2065	2771	2256	81.4%	383	13.8%	101	3.6%	31	1.1%
Low values	1772	2328	2152	92.4%	86	3.7%	41	1.8%	48	2.1%

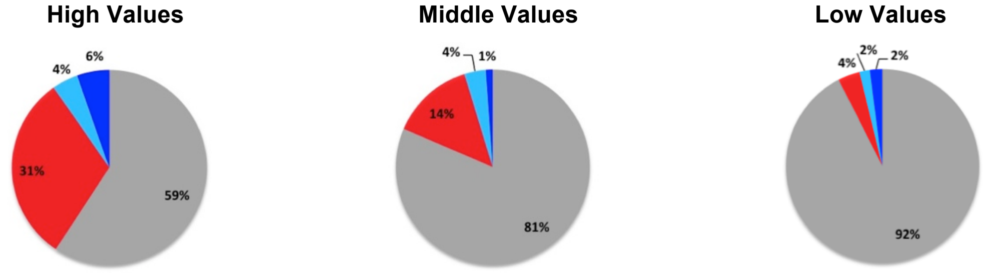


Table 7. Islington, London – building threshold use and network properties for the measure of *combined integration and choice*, radius 800 meters. (c.2013)

TABLE 8 INT_CH R2500	**Façades**	**Doors**	**Domestic**		**Commercial**		**Community**		**Other**	
High values	1797	2557	1525	59.6%	788	30.8%	117	4.6%	127	5.0%
Middle values	1912	2524	2100	83.2%	308	12.2%	81	3.2%	35	1.4%
Low values	1753	2310	2141	92.7%	85	3.7%	43	1.9%	40	1.7%

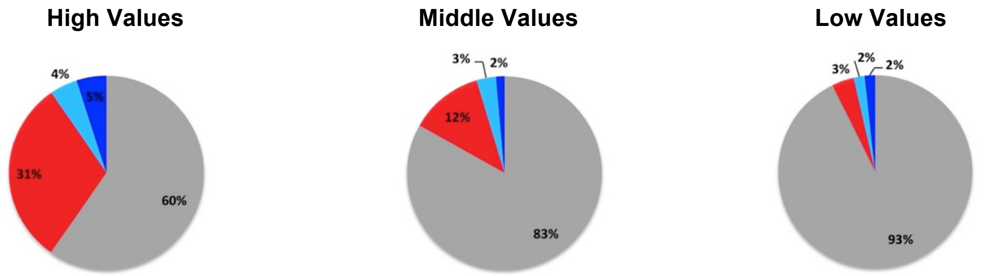


Table 8. Islington, London – building threshold use and network properties for the measure of *combined integration and choice*, radius 2500 meters. (c.2013)

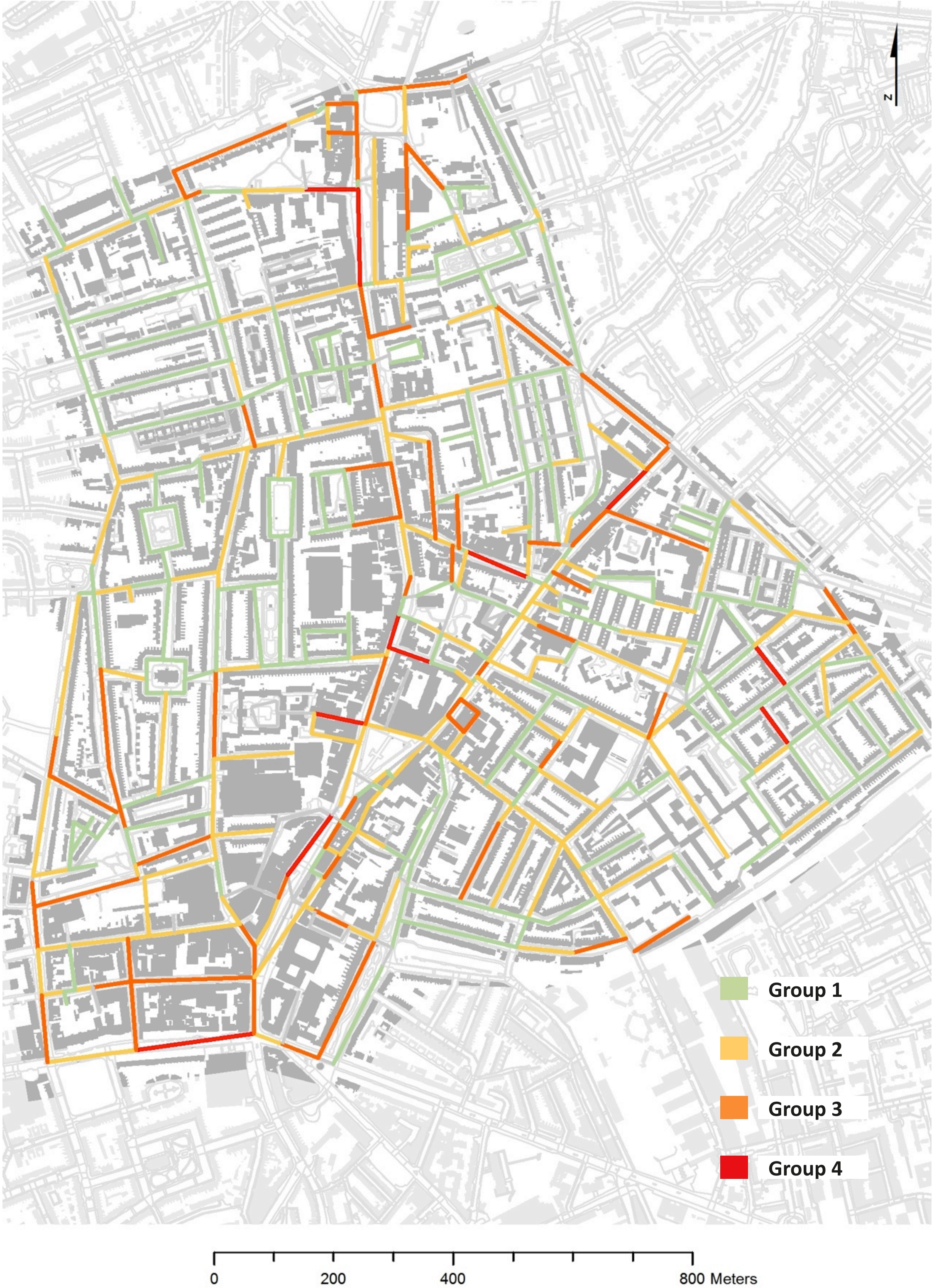


Figure 36. Islington, London – street segments and the mixing of uses. (c.2013)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

To take a step further in understanding land use allocation, our analysis looks at the mixing of land uses at the segment level (Figure 36). This means that segments are grouped in four bands based on the diversity of uses they present. The scale of analysis here, that the impact of the street network on land use allocation is discussed, is the street segment as an entity, not the single segment side – considering that the street network presents the same configurational properties for both sides. 'Group 0' segments refer to street parts with building presence, yet with no building entrances. 'Group 1' segments are monofunctional, meaning that both segment sides are occupied by the same single land use. 'Group 4' segments represent the highest possible mixing in uses associated with building entrances (domestic; commercial; community services; other uses). Analysis confirms that a mixing of uses along the segment length is more frequently observed in segments with higher syntactical values in terms of their location within the street network (Tables 9 and 10). In other words, better-connected streets are more likely to be more vibrant and diverse in their socio-economic activities.

TABLE 9 INT_CH R800	**Segments**	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 0**
High values	180	57 31.7%	79 43.9%	32 18.0%	6 3.3%	6 3.3%
Middle values	180	90 50.0%	52 28.9%	25 13.9%	4 2.2%	9 5.0%
Low values	179	119 66.5%	33 18.4%	13 7.3%	1 0.6%	13 7.3%

Table 9. Islington, London – street segments' mixing of uses and network properties for the measure of *combined integration and choice*, radius 800 meters. (c.2013)

TABLE 10 INT_CH R2500	**Segments**	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 0**
High values	180	49 27.2%	82 45.6%	37 20.5%	7 3.9%	5 2.8%
Middle values	180	98 54.4%	47 26.1%	21 11.7%	3 11.7%	11 7.3%
Low values	179	119 66.5%	35 19.5%	12 6.7%	1 0.6%	12 6.7%

Table 10. Islington, London – street segments' mixing of uses and network properties for the measure of *combined integration and choice*, radius 2500 meters. (c.2013)

Overall, these observations imply organisational consistencies between the distribution of land uses and the way the street network is connected. The socio-spatial logic of the area follows the principles described in Hillier's theory regarding a city's *foreground-background* grid structure (Hiller, 2009; Hillier et al., 2009). In his keynote conference paper at TU Delft September 2009, Hiller explains:

> *'Through the geometry and scaling of their street networks, cities acquire a kind of dual structure, made up of a dominant foreground network, marked by linear continuity (and so in effect route continuity) and a background network, whose more localised character is formed through shorter lines and less linear continuity.'*

In the case of Islington, there is indeed a clear distinction – in its spatial configuration, and accordingly, in its socio-economic function – between the 'quieter' domestic sections (background) and the 'busier', mixed-use, and consequently livelier streets of the urban grid (foreground). The record of building uses indicates a neighbourhood with a functional organisation based on the spatial hierarchy of the significance of its streets, within both the local and the wider street network.

5.3.3. Building-street interface

In addition to an exploration of pedestrian traffic and socio-economic activities taking place on the street domain, the study aims to determine whether the morphological properties of the building-street interface have an impact on the micromorphology of the virtual community. The following analyses examine probabilistic encounters as the product of building morphology and function.

Interface density

Here the methodology addresses the organisational and morphological properties of the building-street interface, again at the ground-floor level. In this respect, two parameters are identified as significant in defining an urban setting at the ground level: firstly, the extent to which a street side is built up; and secondly, the density of building entrances. Both these properties are considered as formative agents of the building-street *interface density*. Furthermore, as clarified in the methodological section, this study aims to provide a more refined representation of the street interface. For this purpose the two aforementioned parameters are examined for each street segment side separately. Analysis calculates the block front/segment length ratio (*bf/sl*) and the *frequency* of building thresholds (*tf*).

Figures 37 and 38 illustrate the results of this analysis. In Figure 35 street segment sides are coloured based on how built up a segment is across its length, comparing the *block front length* to the *segment length*. Figure 36 represents the average building threshold frequency within each block side. On both maps, the more built up and the higher in density of thresholds the segment side, the darker the colours' gradient. To advance the investigation, the analysis integrates a comparison of the present streetscape with the properties of the historical built form. This latter methodological step aims to provide an overview of the way the building-street interface has changed over time (i.e., is the current configuration denser than, similar to, or sparser than the historical one), using as a point of reference the morphological idiosyncrasy of the studied area. In this case, the current threshold frequency is compared to that of a typical historical urban setting built up exclusively with terraces. Figure 39 illustrates the calculation of the *historical threshold frequency/current threshold frequency* ratio (*htf/tf*) for the block fronts in the case study area. The dark brown colour signifies that the street side has developed a denser interface over time, while lighter shades indicate that doorways are found less frequently than across the typical historical façades of the area's terraces.

Figure 37. Islington, London – *block frontage length* per *street segment length* for street segment sides. (c.2013)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

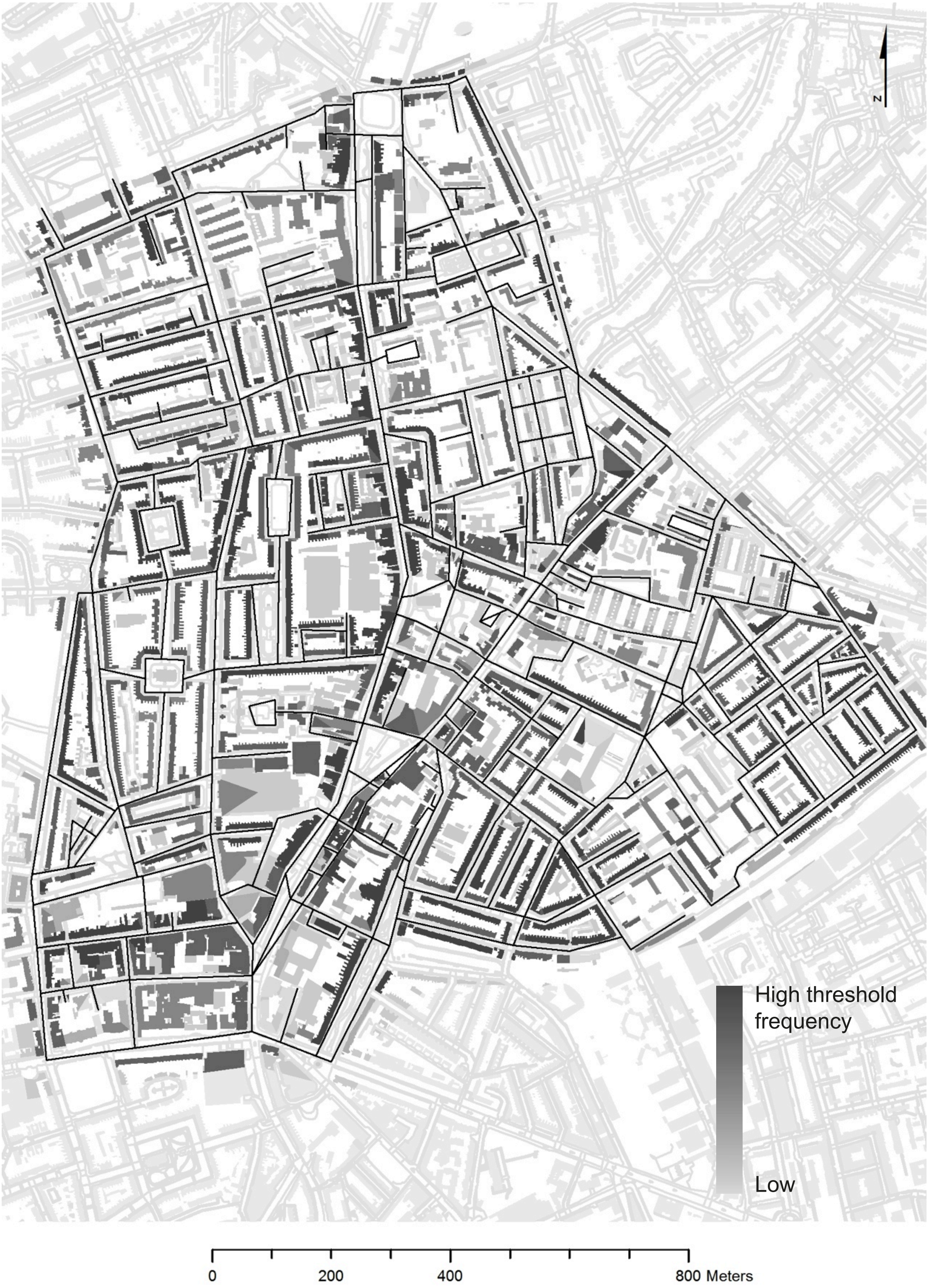


Figure 38. Islington, London – *threshold frequency* for street segment sides. (c.2013)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

Figure 39. Islington, London – *historical threshold frequency* of a terraced house complex compared to the *current threshold frequency* for street segment sides. (c.2013)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

To provide a statistical summary, block fronts are classified based on whether they present a *denser*, an approximately *even*, or a *sparser* building-street interface in comparison to the historical one (Table 11). In this case, this threshold frequency is calculated based the particularities of Islington's terraced streetscape, and is set as one door every 5.8 meters. Approximately one quarter of block fronts in the area have grown denser in doorways (24.3%); a number which matches block fronts with a threshold frequency close to the historical one (22%). However, both percentages are outnumbered by street sides with lower densities in building-street connections (30.6%). This last observation implies the prevailing 'type' of built form change manifested in the area. We can consider the following potential types of building alterations which relate to built form and the frequency of doorways: change that occurs while maintaining the same building shell; or building demolition and/or building replacement. It is then understood that lower threshold densities than the terraced streetscape can be related to the absence of historical terraces and/or incidents of modern, post-modern or later redevelopments. Indeed, Islington has undergone extensive transformations where whole blocks of terraced houses have been replaced by working-class housing schemes[30]. The relationship between building typology and street interface density is further examined later in this chapter.

TABLE 11 Interface density	**Top**	**Middle**	**Low**	**Zero thresholds**	**Zero buildings**	**Total street sides**
Historical / current tf	262 24.3%	237 22.0%	330 30.6%	87 8.1%	162 15.0%	1078
Historical / current tf for direct thresholds	77 7.1%	201 18.6%	413 38.3%	225 20.5%	162 15.0%	1078
Block front length / segment length	581 53.9%	268 24.9%	67 6.2%	N/A	162 15.0%	1078

Table 11. Islington, London – the distribution of *interface density measures* on street segment sides. (c.2013)

[30] For instance, such major building clearances started as early as 1875, under the 'Artisans' and Labourers' Dwellings Improvement Act'. For comments on these redevelopment acts, see the Old Ordnance Survey Maps, Highbury & Islington, The Godfrey Edition, c.1871; and from the same series, Clerkenwell, King's Cross & The Angel, c.1914.

In the following paragraphs, the analysis looks at two more properties of the building-street interface: the associated building *function* and the type of the interior-exterior *transition*.

Function and transition

Relating the recorded land use data with the aforementioned 'built form' measures, it is possible to investigate whether there is a pattern that associates particular land uses (domestic and non-domestic) with a higher or lower building-street interface density. Table 12 summarises for each segment side type a breakdown of the land uses associated with the threshold counts. In the area studied, in those street sides densest in doorways, only one in five entrances is related to a non-domestic land use. However, it is also interesting to note that these are most likely (88.7%) to be commercial entrances. In contrast, 'historical' and 'low' block fronts present a greater mixture of non-domestic land uses. It is interesting to point out that block fronts with a low threshold frequency have the highest percentage (11.5%) of community services (such as schools, churches etc.); these services are frequently located in large buildings, which may take up a whole block frontage, and which generally offer few entrances.

TABLE 12 *Htf / tf*	**Façades**	**Doors**	**Domestic**	**Commercial**	**Community**	**Other**	**Direct**
Denser than historical	2600	4053	3300 81.4%	668 16.5%	51 1.3%	34 0.8%	2684 66.2%
Historical	1721	2146	1684 78.5%	328 15.3%	53 2.5%	80 3.7%	1244 58.0%
Sparser than historical	982	1186	777 65.5%	185 15.6%	136 11.5%	88 7.4%	597 50.3%

Table 12. Islington, London – *building threshold uses* based on the distribution of *historical / current threshold frequency ratio* on street segment sides. (c.2013)

Figure 40. Islington, London – building interior-exterior transition; *direct* and *indirect* building thresholds. (c.2013)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

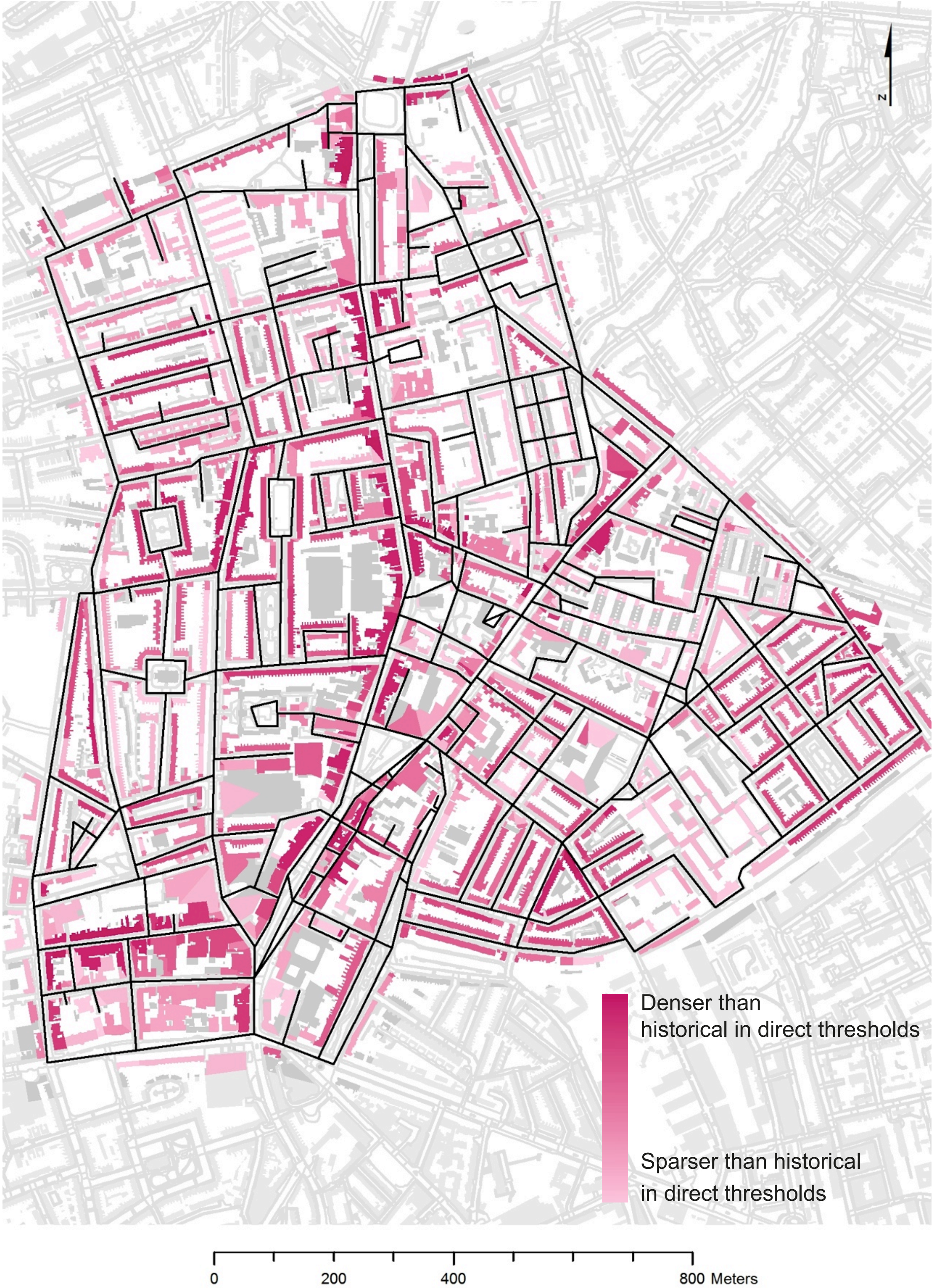


Figure 41. Islington, London – *historical threshold frequency* of a terraced houses' complex compared to the *current threshold frequency* for street segment sides considering only direct entrances. (c.2013)

It is essential to study these differences in use because building function has a direct impact on the morphology and configuration of the building-street interface. The type of transition from the public to the private domain provides a basic indication of a building's interior-exterior relationship. Direct accessibility between the two domains implies respectively proximity between the building interior and the street domain and a higher potential for interior-exterior/private public interaction. Secondary thresholds enhance separation of the building interior from the street domain. Figure 40 maps the primary and secondary thresholds within the case study area. Table 13 relates this record to the land uses associated to each threshold (shown earlier in Figure 32). The data suggest a consistency between land use and the mode of private-public transition. Commercial uses present almost exclusively direct entrances (95.8%); this is not surprising as such uses usually aim to be 'outward looking' and accessible to the pavement users. The highest percentage of indirect entrances is observed in residential buildings and community services.

TABLE 13 Building thresholds	**Doors**	**Domestic**	**Commercial**	**Community**	**Other**
Direct thresholds	4980	3540 (61.4%) 71.1%	1131 (95.8%) 22.7%	144 (59.5%) 2.9%	165 (81.7%) 3.3%
Indirect thresholds	2411	2226 (38.6%) 93.2%	50 (4.2%) 2.1%	98 (40.5%) 4.1%	37 (18.3) 1.5%
Total	7391	5766 78.0%	1181 16.0%	242 3.3%	202 2.7%

Table 13. Islington, London – building threshold *uses* and *type of transition*. (c.2013)

It is clear, then, that an important influence on building-street interfaces is the type of interior-exterior transition, and more particularly the presence of primary building entrances. Using the record of direct and indirect thresholds as mapped in Figure 40, it is possible to examine the frequency of direct entrances in a region's block fronts. Again, assuming a direct entrance per terraced house, it can be estimated whether these block fronts have become denser in direct connections over time (see Figure 41). Subsequently, by relating the frequency of direct entrances to associated land uses, it becomes clear that the 'highest' presence of direct building-street connections is more likely to be accompanied by non-domestic uses, and therefore a more 'public' profile in terms of activities (see Table 14).

This observation is also confirmed when considering the presence of indirect thresholds in segments whose sides are not built up to a great extent (Table 15; 57.4%). Results from the Islington study area indicate that sparse building-street connections appear to be more prone to a configurational separation from the street domain, meaning that additional steps or barriers separate the building function from the street function. This reinforces the argument that the higher the density of the building-street interface – the more built up and dense in thresholds it is – the greater the potential for probabilistic encounters of interior-exterior space users. This high density also increases the co-presence of users and occupancy at the sidewalk, as well as surveillance, and overall probabilistic street activity (Zako and Hanson, 2009).

TABLE 14 *Htfp / tfp*	**Façades**	**Doors**	**Domestic**	**Commercial**	**Community**	**Other**	**Direct**
Denser than historical in primary thresholds	642	1034	487 47.1%	524 50.7%	5 0.5%	18 1.7%	938 90.7%
Historic	2174	3082	2694 87.4%	312 10.1%	44 1.2%	32 1.0%	2232 72.4%
Sparser than historical	2035	2760	2111 76.5%	343 12.4%	158 5.7%	147 5.3%	1364 49.4%

Table 14. Islington, London – *building threshold uses* based on the distribution of *historical / current threshold frequency ratio* of direct entrances on street sides. (c.2013)

TABLE 15 *bf / sl*	**Façades**	**Doors**	**Direct thresholds**
up to 3/3 of the segment length built up	4386	5968	3874 64.9%
up to 2/3	968	1289	604 46.5%
up to 1/3	108	128	47 36.7%

Table 15. Islington, London – *building threshold type* based on the distribution of *building densification* on street sides. (c.2013)

The role of the street function

Besides the building function, the micromorphology of the sidewalk is equally influenced by the street function as a pedestrian route (Desyllas and Duxbury, 2001). The levels of exterior pedestrian traffic, in combination with the pavement width serving this traffic, have an impact themselves on the morphology of the building entrance (Palaiologou and Vaughan, 2012; Palaiologou, 2012). For instance, where there are high pedestrian flows and a narrow pavement width, one is more likely to find direct thresholds which stand back from the building line giving way to pedestrians. In quieter street domains, the micromorphology of the sidewalk can be more playful, with secondary thresholds such as stoops or areaways being projected into the pavement width. This is confirmed by the data from the survey of thresholds and the configurational analysis of the street network: Tables 16 and 17 show the type of interior-exterior transition (direct/indirect) in relation to the syntactical properties of street segments.

TABLE 16 INT_CH R800	**Façades**	**Doors**	**Direct**		**Indirect**		**Blank**	
High values	1625	2292	1670	72.9%	622	27.1%	100	4.4%
Middle values	2065	2771	1748	63.1%	1023	36.9%	176	6.3%
Low values	1772	2328	1562	67.1%	766	32.9%	178	7.6%

Table 16. Islington, London – *building threshold type* for the syntactic values of *combined integration and choice* for radius 800 m grouped in tertiles. (c.2013)

TABLE 17 **INT_CH** **R2500**	**Façades**	**Doors**	**Direct**		**Indirect**		**Blank**	
High values	1797	2557	1865	72.9%	692	27.1%	126	4.9%
Middle values	1912	2524	1576	62.4%	948	37.6%	156	6.2%
Low values	1753	2310	1539	66.4%	771	33.4%	172	7.4%

Table 17. Islington, London – *building threshold type* for the syntactic values of *combined integration and choice* for radius 2500 m grouped in tertiles. (c.2013)

So far the discussion has referred on the one hand to the spatial logic of land use allocation, and on the other to variations in the organisation and morphology of the building-street (interior-exterior) transition. At this stage, the following observations can be summarised:

- The analysis of the street network configurational properties with the use of space syntax measures revealed the spatial structure of the area: the importance of the commercial routes of Upper Street and Essex Road which stand out in terms of accessibility from the residential background.

- The results of the syntactical analysis were compared with the properties of the street interface in terms of: (a) land use allocation – as this was mapped based on the survey of building thresholds; and (b) frequency of building thresholds – as this was measured with the use of the interface density measures that this study developed. This micro-scale analysis found that those streets with a prevailing non-domestic use and a greater potential in pedestrian flow (namely, greater significance within the street network) are likely to display a higher frequency of direct entrances.

- In turn, these streets are more likely to comprise places of vibrant socio-economic activity and urban-like character. In the case of Islington, the most obvious examples of such streets are Upper Street and Essex Road.

These results indicate that *the urban grid structure impacts on the functional homogeneity or mixture of the street interface*, and hence to its potentials for a diverse micromorphology of the pavement configuration. The next step, then, is to relate these observations to the architecture of buildings in order to further explore the effect of building morphology on the micromorphology of the street interface. In Chapter 5, Part B an analysis is applied to the varying street qualities supported by those building typologies most popular in the case study area: terraced houses, and ‘council’ or ‘social’ housing schemes. Explorations are centred on a comparative consideration of the different street qualities that these two contrasting architectural and urban complexes have generated over time.

5B

Chapter five - Islington, London

(Part B)

In this second part of Chapter 5, a reading of the built form in Islington is presented in Section 5.4, including a survey of the relevant building types and their associated potential to support street interfaces of functional and morphological diversity at the micro-scale. Section 5.5 visits various urban districts within the case study area to discuss whether their profile hinges on the interplay of their spatial, physical and social context. In its closure, this chapter looks for indications of a spatial logic in the distribution of urban change, whilst raising a query for Chapter 6: are there any morphological affordances that pre-set the potentials for built form adaptation to urban change?

5.4. The built form

5.4.1. Building types

It is essential to begin with a survey of the building stock across the study area. Figure 42 maps the presence of varying building types around Upper Street. The mapped building record distinguishes between: (1) the surviving terraced buildings; (2) council

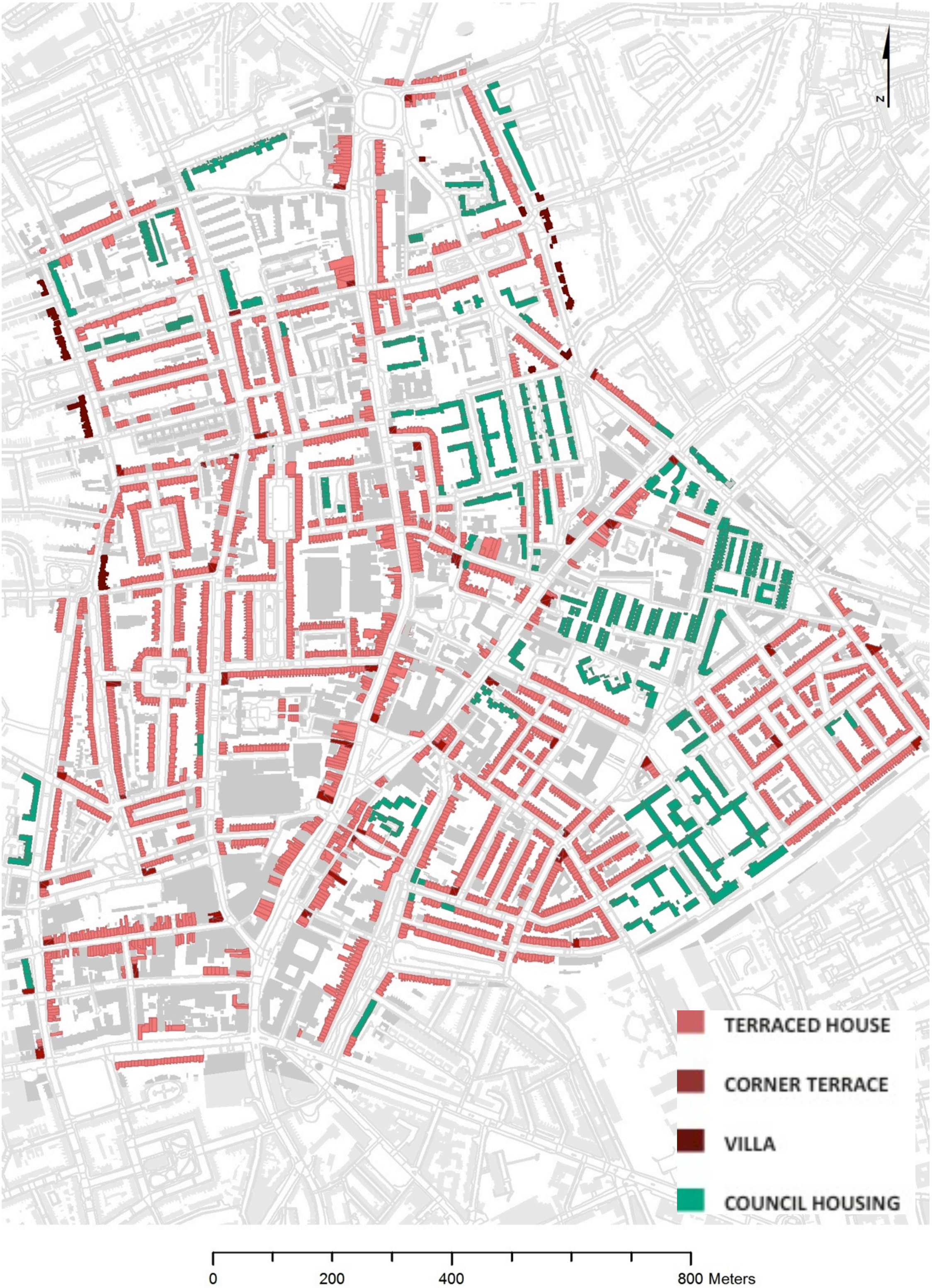


Figure 42. Islington, London – building types. (c.2014)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

housing buildings; and (3) the remaining buildings with varying chronological-architectural origins and functional purposes (titled as 'other').[31] Terraced houses in the area originate mainly from late Georgian and early Victorian times. Council housing redevelopments are younger and date back to 1877 when the first housing scheme was provisioned for the area around the Peabody Trust in Greenman St (south of Essex Rd).[32]

TABLE 18 Islington Building types	**Façades**	**Doors**	**Total façade length (km)**	**Mean façade length (m)**	**Door encounter rate**
Terraced house	3656	3978	21.4	5.8	5,4
Corner terraced	97	150	1.2	12.8	8.0
Villa	45	49	1.9	9.4	8.2
Council housing	384	450	5.6	14.6	12.4

Table 18. Islington, London – *building types* and street interface. (c.2013)

Terraced houses comprise the majority of buildings: more than two thirds of the façades in the area belong to a terraced building (3,753 façades out of 5,326 in total) (Table 18). Villa façades, a reminder of the one-time 'suburban retreat' character of Islington, are recorded among the buildings, but number only 45, and are found primarily in the districts of Barnsbury and Canonbury at the edges of the case study area, namely at a significant number of turnings away from the commercial arteries of Upper Street and Essex Road. At 7.3%, council housing buildings are almost ten times less prevalent than terraces. However, these housing complexes are the

[31] This latter category refers to buildings which do not belong to a particular *type* and are mostly later developments.

[32] For a detailed description of Georgian and Victorian terraces refer to Muthesius, 1982, p. 147-176. Also, a detailed account of Islington council housing can be found at the Islington Council's *Social Housing Review, 2011/12*, available at: < http://www.islington.gov.uk/publicrecords/library/Housing/Business-planning/Policies/2012-2013/(2013-02-05)-Islington-Social-Housing-Review-2011-12.pdf >

assemblage of buildings which are larger in scale than the modest terraced house, such as slabs or towers (Sherwood, 1978). These buildings have a greater footprint area, a longer building perimeter and subsequently bigger building façade length: the mean façade length for terraces is 5.8 meters, while for the council housing blocks this increases to 14.6 meters. This means that, while terraces are ten times more in number, their façades occupy only four times more street length than that comprised by council housing façades.

Though longer, council housing façades are not so open in their interaction with the street. Julienne Hanson has extensively examined in her study of Somers Town (Hanson, 2000) the built form features responsible for this inward facing morphology – and subsequently, the potential social enclosure of these buildings. Data for the area of Islington confirm that building-street connections are far more frequent in terraces than they are in council buildings. Walking on a street of terraces (in their present state) a pedestrian would anticipate encountering on average a building entrance every 5.4 meters. When surrounded by council blocks, however, a pedestrian would experience a less dense building-street interface, with the door spacing increasing to an average of 12.4 meters.

Building types and building-street interface

In the streetscape of Islington it is quite likely that a pedestrian would come across a block side formed exclusively by a singular building typology. Within the case study area there are many surviving block fronts lined up solely with historical terraced houses, as well as blocks with their sides occupied entirely by council housing buildings. At the same time, there are locations on the grid where more recent buildings join the historical terraced houses across the same block side, consequently imbuing block fronts with a greater mix of morphological properties. In order to not exclude these morphologically fused street parts when discussing the density of building thresholds, and therefore to understand the properties of the urban streetscape more realistically, we can consider each *building typology* in relation to the recorded *interface density* measures discussed earlier (*bf/sl* ratio; *htf/tf* ratio; *htfp/tfp* ratio).

Shows on top the block front length / segment length distribution on street sides for the different building types in Islington; in the middle: the threshold frequency on street sides for the different building types; and at the bottom, the frequency of direct thresholds on street sides for the different building types.

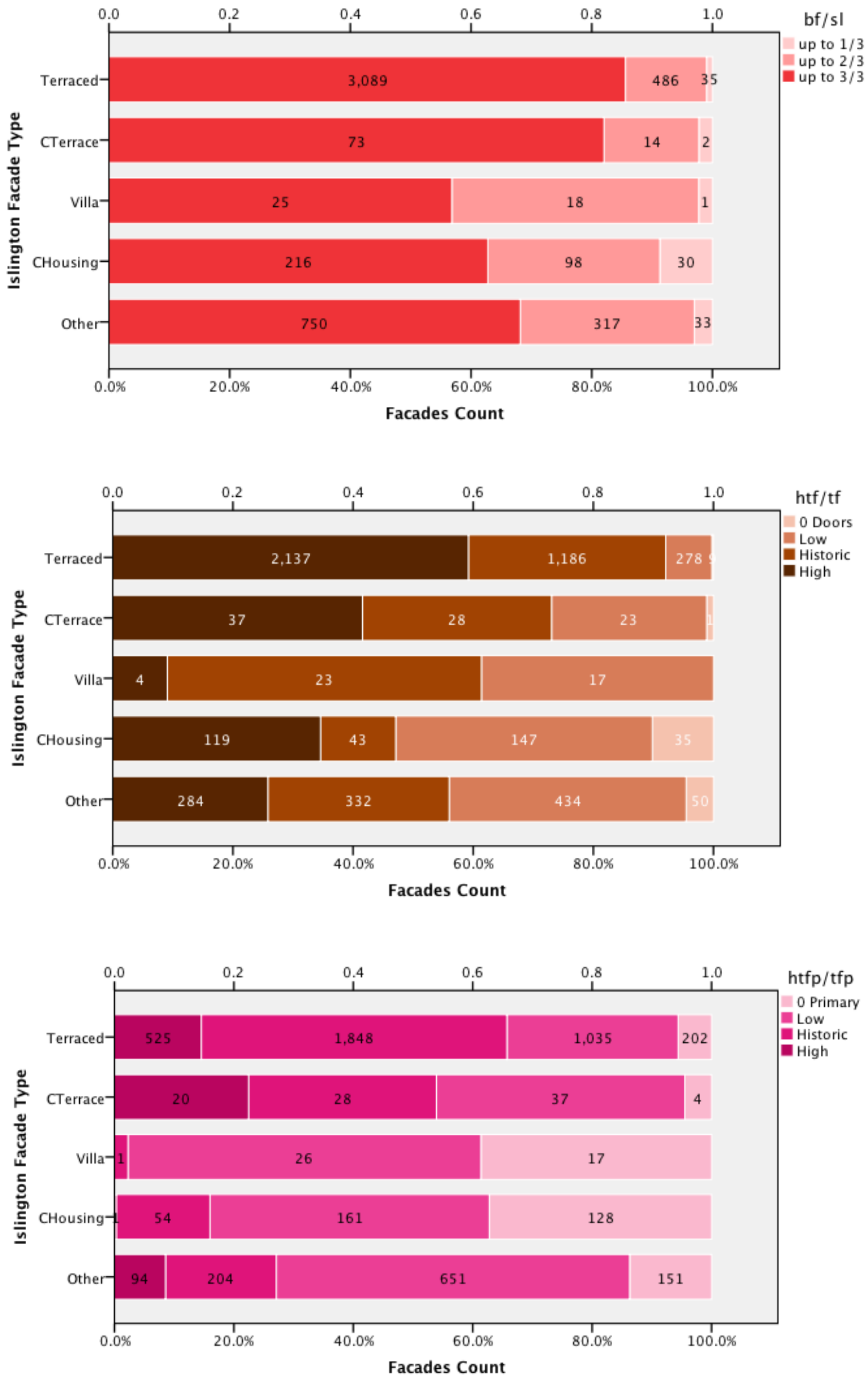
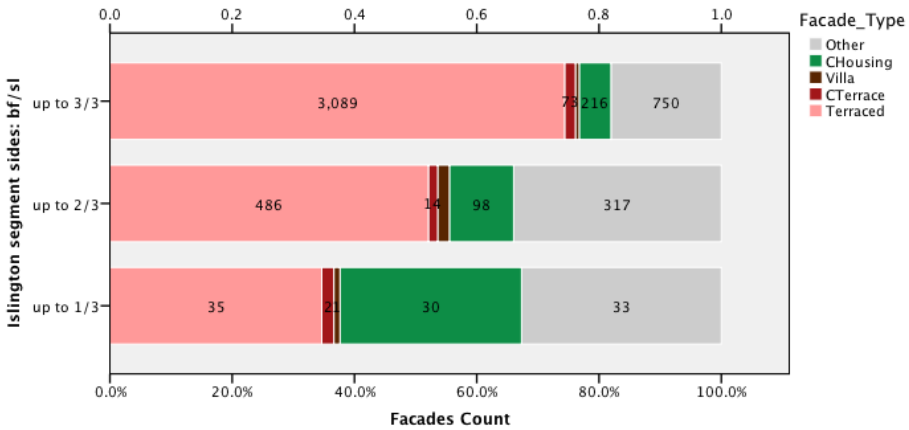
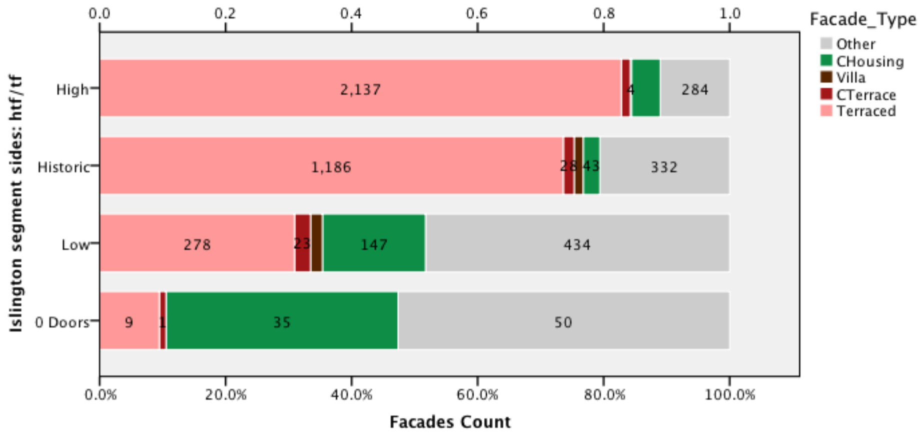


Figure 43-45. Islington, London – building types and block fronts. (c.2014)

Shows on top the different building types distribution for the block front length / segment length classification of street sides in Islington; in the middle: the different building types based on the threshold frequency classification of street sides; and at the bottom: the different building types for the frequency of direct thresholds classification.





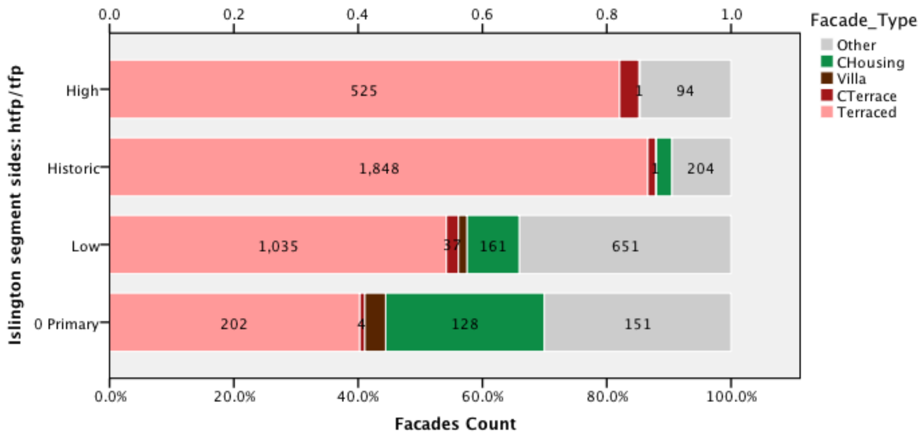


Figure 46-48. Islington, London – block fronts and building types. (c.2014)

There are two ways of interpreting results from this descriptive analysis. Firstly, we can look at the street interface density patterns for each building typology (Figures 43-45), and secondly we can examine the presence of the various building typologies for each segment side type (Figures 46-48). Starting from the *block front length/segment length* ratio (Figure 46), it can be seen that in Islington, street sides with very little presence of built volume (buildings up to one third of segment length) mainly constitute building types other than terraced houses (62.4%). Notably, the less built up a side is, the higher the percentage of council housing buildings; the opposite is observed for terraced houses. Results are similar for measures of *threshold frequency*; both with all thresholds considered (*htf/tf*; see Figure 47), and when taking into account only direct building entrances (*htfp/tfp*; Figure 48). The percentage for terraced house façades drops significantly – moving towards lower threshold frequency. In contrast, council housing buildings are found in only 4.6% of block fronts with high frequency of doorways (and almost zero presence when looking at high frequency of direct entrances); while these buildings take up more than one third of the overall built form on segment sides with no doors (36.8%). Finally, when looking at Figure 44, a general observation comes to the fore regarding building-street connections over time: terraced houses, above all building types, support the highest percentage of block fronts which have grown denser in thresholds (59.2%). In other words, the terraced house typology allowed the development of the greatest potential for probabilistic encounters.

Looking for further clues regarding the historical transformation of the terraced streetscape, we can refer back to the survey of building functions, and more particularly at the *mixing of uses*. The main enquiry here is to understand whether street segments built up with terraces became not only denser over time, but functionally more diverse as well. Table 19 provides an overview of the distribution of terraced buildings and council housing in street segments divided evenly into four groups: *low* mixing (Group 1) to *medium low* (Group 2) to *medium high* (Group 3) to *high* (Group 4) diversity of uses along their length[33] (see earlier in Figure 36). Terraces and council buildings were primarily designed to cater for domestic uses. It is therefore expected that for both typologies the majority of building units will be traced on street parts that are mainly, or even exclusively, domestic. Almost half of

[33] Some clarifications: The 'other buildings' group refers to buildings which are not of a specific architectural style and which do not present any typical morphological features; in this category buildings of all sorts of function are included, such as retail spaces, churches, schools, theatres, and hospitals.

the terraces (45%) and more than half of the council buildings (59.4%) comprise street parts with a mono-functional profile. The second trend for both typologies is their presence in street segments where the combination of only two primary uses is observed; 35.9% of terraces and 21.6% of council housing are found in 'Group 2' segments. Finally, when looking at street parts with greater functional diversity (Groups 3 and 4) the presence of terraced buildings becomes slightly higher in comparison to the one of council buildings.

TABLE 19 Building types and uses' mixing	**Façades**	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 0**
Terraced house	3753	1690 73.7%	1343 74.7%	583 65.5%	127 71.7%	10 18.5%
Villas	45	37 1.6%	6 0.3%	2 0.2%	0 0%	0 0%
Council housing	384	224 9.9%	81 4.6%	52 6.0%	3 1.7%	24 44.4%
Other	1024	339 14.8%	366 20.4%	252 28.3%	47 26.6%	20 37.1%

Table 19. Islington, London – *building types* and mixing of uses on street segments. (c.2014)

Reversing the analysis query for results in Table 19 provides a better understanding of how functional diversity is distributed amongst building types. This time we can calculate the proportions of building typologies recorded for each one of the aforementioned segment groups. It then becomes clear that all groups, from 1 to 4, are predominantly constituted by terraced buildings. At the same time, the percentage of council housing buildings decreases with greater mixing of uses. The most notable observation here is that almost half of street segments with no building threshold recorded along their length (Group 0), are built up with council housing buildings (44.4%). The presence of terraces in such segments is far less (18.5%), whilst the remaining buildings with blank sides are of no specific architectural typology (37.1%). Overall, it can be understood that, with its strong and dominant presence in all groups of functional mixture (Groups 1-4), the terraced building typology can support varying socio-spatial situations and street profiles, from entirely residential street parts to more mixed-use urban-like situations.

Building types and building-scale diversity

To achieve a more thorough examination of the potentials for functional mixture depending on building types, our analysis focuses in on the building scale and records the variety of uses within a building unit. In particular, the *commercial-residential* units and *mixed-use* units are located, counted, and grouped based on their building typologies. Here, the term 'commercial-residential' unit is used after Davis (2009, p.4) to refer to buildings which combine domestic and commercial uses, without necessarily implying a relation between the inhabitants of each use. The two building functions are independent in terms of accessibility, yet both are contained to the same building shell, forming a hybrid morphological unit.

Davis (2009), in his extensive cross-cultural research on urban buildings housing both a dwelling function and a work/retail space (usually placed at the ground level), organises the fine differences between the varying manifestations of this 'urban hybrid', as the author calls this building type. In his work, Davis distinguishes the *shop/house*[34], the *family shop/house*, the *commercial/residential building* and the *mixed-use building*, highlighting the universally historical pivotal role of these units and their inherent morphological flexibility and sustainability in supporting varying socio-economic micro-structures of urban life. With its long-standing terraced buildings London provides excellent examples of these shop/house variations.

In his narrative of the London shop/house history (2009, p.67-74), Davis describes how, in their English version, shop/houses originate from the 'farmhouse' which evolved to form the typical terraced urban building. The massive spread of terraced houses across London streets as the city became more urban, along with the flexibility of the terraced floor plan, allowed these buildings to easily incorporate in their configuration small businesses alongside a primary domestic use[35] (see discussion in Chapter 3). Going back in the past to London's historical streets via the study of London business directories (c.1925), Davis highlights (2009, p.71-73) the popularity of this hybrid building type, citing as an example the rows of many mixed-use terraces in Barnsbury Road in Islington (a street also included in the case study here). The author observes that none of the businesses recorded in the past exists in the present day. However, these buildings remain in their place after cycles of

[34] Or *shophouse* for Asian cultures.
[35] For an extensive study on the configurational properties of the terraced house, see Hanson (1998), *Decoding Homes and Houses.*

transformation, and stand as living proofs of their adaptability in the shifting socio-spatial context of the city's urban history (Davis, 2006, p.149-154; Törmä, 2014).

The building thresholds survey in the case study area for c.2013 performed for the purposes of this study shows that in many instances the terraced building continues to shelter to the present day more than one primary use within its modest size. Notably, the majority of *commercial-residential* – and in general *mixed-use* – buildings recorded within the study area belong to the terraced building typology (see Table 20). In contrast, only three mixed-use council buildings are found. The remaining buildings with a mixture of uses are not of a particular morphological type.

TABLE 20 Building scale functional mixing	**Terraced house**	**Villa**	**Council housing**	**Other**	**Total**
Commercial Residential	384 73.7%	0 0%	3 9.9%	59 14.8%	446
Mixed-Use	350 74.7%	0 0%	3 4.6%	128 20.4%	541

Table 20. Islington, London – *building types* and mixing of uses at the building scale. (c.2014)

This observation does not necessarily imply that terraces are the most altered buildings. Indeed, there are other buildings in the area which have undergone major transformations over time. One such case is the former Angel Hotel, whose brown brick surface has stood across from Angel Station for over a century (built in 1899; see Figure 49). This six-storey Victorian building opened its doors as an Inn, to become twenty-three years later a café-restaurant (called the Lyons' Café), and it served as the institutional facility of the University of London's Geology Department until the late 1970s. A decade later the building became designated for bank use and still operates as a bank branch today. Another example of this interior remodelling for a different building function is the former Islington Congregational Chapel and school, located at 311 Upper Street. This red brick building has survived for 126 years (built in 1888-9) and is used nowadays as a recording studio.

c. 1890s.

c. 2014

Source: *http://pubshistory.com/LondonPubs /Clerkenwell/AngelInn.shtml*

Figure 49. Angel, Islington - 'the Angel Hotel'.

However, these internal changes in building use have not altered dramatically – if at all – the interface of these buildings with the street. One function has replaced another without leaving notable morphological imprints on the building façade. This is partly due to the fact that many of these historical buildings became listed, and partly due to the morphological features of the buildings themselves, which entailed a more-or-less firm structure of the building shell. In general, these buildings were at first instance purpose-built, bigger in size and more public in their character than the small-scale ordinary urban terraced house. Due to the building purpose, utility, size and morphological particularities, interventions in this case are programmed and not the random result of generative processes and informal appropriations in the built form and function – as usually is the case for terraced houses.

Against this background, terraces stand out in terms of their potential for adaptability due to the level of their historical standing and the ease of their adjustment to the needs of common, everyday living. Over time, these buildings have been called upon to support a functional mixing which combines a more public interface alongside a private domestic entrance. In doing so, the narrow terraced house façade is often exposed to as much morphological change as possible, taking advantage of the potentials for building/plot subdivision, and hence of the potentials for high interface density – and at the same time openness – towards the street domain (Figure 50). Such interventions are mainly informal and piecemeal projects which result in aesthetic variations whilst maintaining organisational consistencies. Each building is likely to change at a different point in time than the buildings adjacent to it, for a different functional purpose and with dissimilar architectural gestures. Nevertheless, these changes follow a norm which is imposed by the typological commonalities of the terraced house floor plan configuration. The terraced typology presents at once an inherently double function as an autonomous building unit on the one hand, and as a sub-unit of the block aggregate on the other. In the case of terraces (and of row housing in general) the rules of aggregation strengthen further this parts-whole relationship. Across the row, the fundamental morphological rules governing the type (window alignment, façade width etc.) encourage the maintenance of a block frontage with an aesthetical and morphological continuity and consistency. These architectural consistencies are further supported by the building culture itself. Citing the English terraced house as an example, Davis notes (2006, p.153):

> *'A smooth evolution of a building type may be facilitated by a fine-grained network of players in the culture. Each player is able to apply individual discretion within a framework of overall cultural understandings.'*

Figure 50. Liverpool Road, Islington, London – terraced house façade alterations. (c.2014)

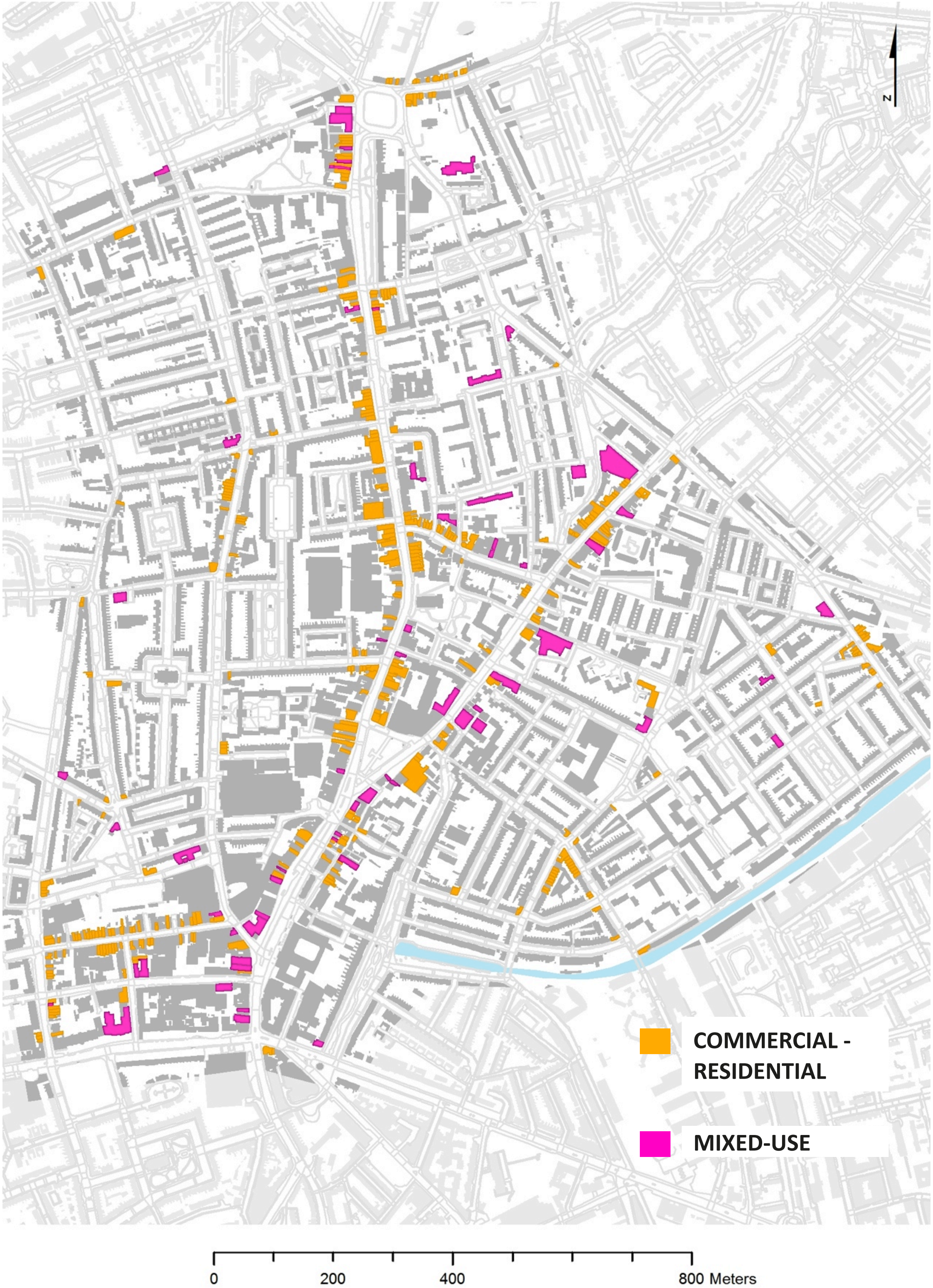


Figure 51. Islington, London – *commercial-residential* and *mixed-use* building units. (c.2014)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

Walking through the streets of Islington, a pedestrian finds both single instances of mixed-use building units within a terrace, and cases where entire terraces, or even entire street parts, have a mixed-use character. Figure 51 maps mixed-use buildings in general, and commercial-residential units in particular[36], within the study area. The majority of these buildings are found at the street sides of Upper Street and Essex Road, reflecting once again the spatially structured logic of land use allocation within the area (discussed earlier in Section 5.3.2).

From the street survey and on-site observation of these buildings, a number of interesting phenomena are observed. These are of note since they strengthen the argument that the terraced house typology has throughout time supported local urban life, responding to its persisting, and shifting, needs. The first observation is the regular appearance on the map of commercial-residential units which occupy corner sites of residential blocks. These buildings are slightly larger in size than the regular terraced house and are frequently historical public houses which continue to constitute local places for social gathering to the present day (Figure 52). Public houses retain a long-standing significance in British culture, supporting socialisation and sustaining local life.

Figure 52. Islington, London – corner terraces, public houses. (c.2014)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

[36] This study considers commercial-residential units as a sub-category of mixed-use buildings.

Figure 53. Islington, London – altered terraced façades with ground floor extension towards the street. (c.2014)

A second observation refers to the extent to which the terraced façade is altered in order to facilitate the introduction of any new function into the domestic building. The survey records cases where the ground floor has been extended outside the original building line and an entirely new front built; the extent to which this reconfigured interface is open to the public depends on the type of use introduced at the ground floor (see earlier Figure 50). In general, these architectural interventions appear as clusters within terraces. This implies the possibility of the same builder and owner of particular building units, or is a further manifestation of the incidents of morphological adoption and repetition as a 'neighbour effect' (Whitehand, 2001, p.107) – this is arguably also the case for the semi-detached house, according to Whitehand and Carr (1999). Figure 53 maps the location of all such instances where the building façade has been extended to occupy part of the street domain, forming a local architectural idiom. With historical research into the street configuration, built form and uses of these street parts, we can better understand the spatial implications of this local urban phenomenon. The following paragraphs present such an example, looking at the built form history of Chapel Street.

5.4.2. Change and morphological rhythm: parts and wholes

Chapel Street, at the southwest side of the case study area, is one such urban area where shifts in building use and their subsequent built form transformations are recorded. Only two blocks long, the street is bounded by Penton Street at its western end, and Liverpool Road at the eastern. Being 'two steps' away from Islington High Street (in syntactical terms, two angular changes in direction), the ground floor interface of Chapel Street became gradually over time occupied by an increasing number of commercial uses. Such is the shift in the socio-economic profile of the street that today it is known as Chapel Market, reflecting its role as the largest street market in the borough of Islington[37].

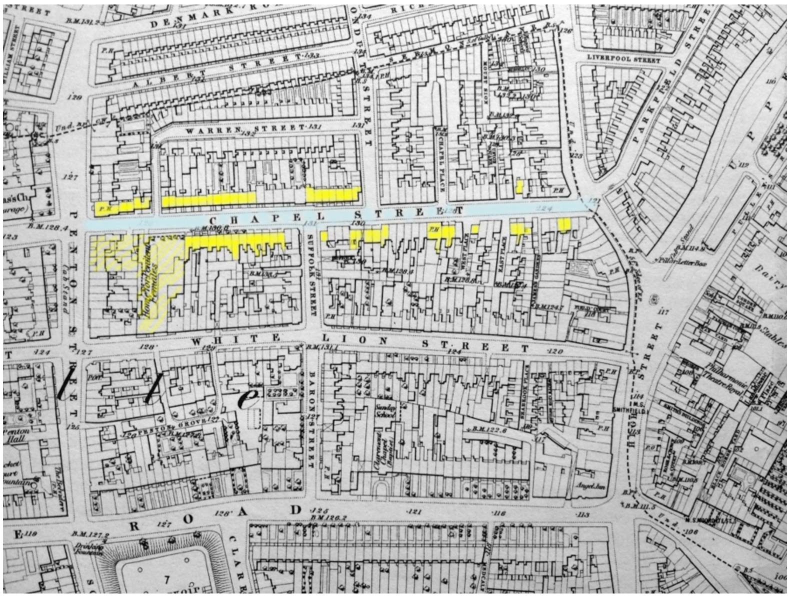
A comparison of building footprints in Chapel Street, using those recorded in historical Ordnance Survey maps at different periods of time, indicates instances of built form change and an approximate time range within which these changes have occurred. Figure 52 brings together a sequence of Ordnance Survey historical maps for c.1871, 1894 and 1914[38] showing the area around Chapel Street. Shifts in building footprints

[37] Source: http://www.islington.gov.uk/services/business-licensing/opportunities/street_trading/Pages/1435.aspx
[38] As published in the Alan Godfrey Editions.

facing Chapel Street from one time period to the next are marked in yellow. In addition to historical maps, the London's urban past can be re-visited and examined in great detail using the highly precise building use records of the *Post Office Commercial and Professional Directories*. These detailed records constitute a rich source from which to glean a historical and socio-economic profile of the city's streets. Table 21 presents a sample from the collected account of historical commercial and professional uses for the buildings in Chapel Street (see in Appendix, A4) for the complete historical research, for the whole street), confirming the relationship between changes in built form and shifts in building use. The records retrieved from the Post Office Directories show not only the frequency of alterations, but the many, diverse functions accommodated by the terraced house: from furniture dealer, to butcher, to tailor. Travelling back to the terraces of Chapel Market's history, one encounters occasions where the same type of business continues under different ownership in the same premises, or cases where the terraced unit is refurbished to house a wholly different type of business and trade.

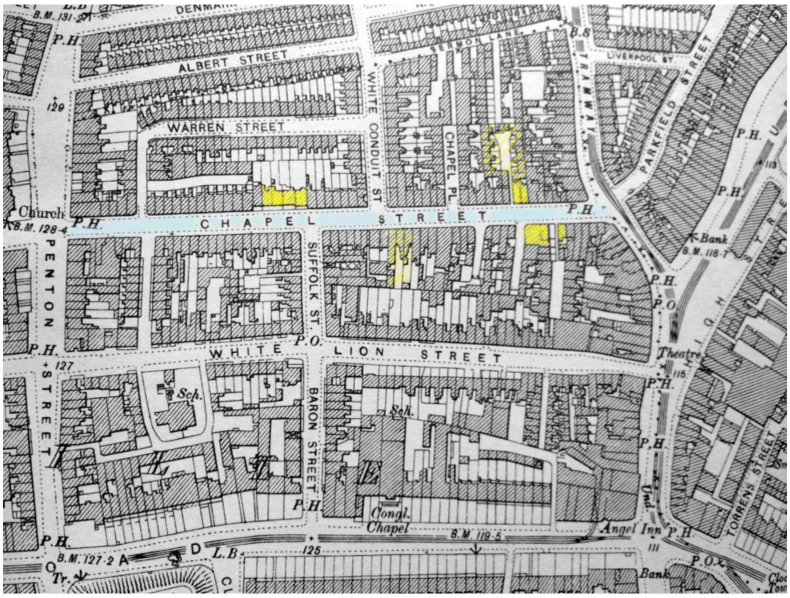
TABLE 21 Chapel St. Building No	**c.1852**	**c.1895**	**c.1915**
1	-	Lutteridge Charles Henry, greengrocer (p.1207)	-
2	Hawkins George, furniture broker (p.784)	Wall Charlotte Ann (Mrs.), baker (p.1493)	Werner William, baker (p.1314)
2 A	-	-	Ciotti Angelo, confectionter (p.814)
3	Cooksley John, slater (p.677)	-	Reynolds & Mundy, butchers (p.1181)
4	-	Benjamin Solomon, miscellaneous dealer (p.819)	Benjamin Solomon, linendraper (p.743)
5	-	Hussey Thomas, paperhanger (p.1124)	-
7	Oseman William, bricklayer (p.910)	-	-
8	-	Konskier Nathan, job draper (p.1167)	Sandow Ryman, milliner (p.1208)
10	Robinson George, prof. of music (p.956)	Phillips Loo, wardrobe dealer (p.1311)	Reynolds & Mundy, butchers (p.1181)

Table 21. Islington, London – *Chapel Street*; historical building uses.



From c.1871 to 1894.

Background map, c.1894 – changes marked in yellow.



From c.1894 to 1914.

Background map, c.1914 – changes marked in yellow.

Figure 54. Chapel Street, Islington – historical building footprints transformation.

Background maps: © Alan Godfrey | Old Ordnance Survey Maps, *Clerkenwell, King's Cross & The Angel*, c.1894 and 1914.

Combining these historical readings – of built form on the one hand, and its utility and purpose on the other – it can be inferred that the surviving terraced buildings did not always present their current morphological features. Many of the historical terraced houses of Chapel Street, now occupied by non-domestic uses, were originally set back from the plot line. Examining closely the Ordnance Survey maps (Figure 54) it is noted that between c.1871 and c.1894 almost an entire block front at the northwest side of Chapel Street was extended to meet the front plot line, covering the previous private areaways. Looking at the present image of these blocks (c.2014) (Figure 55), it can be seen that this built form transformation refers to an alteration of the existing historical building volume. The historical terraced façade has retained its former morphology on the upper floors, whilst on the ground floor it has been modified to host the newly introduced non-domestic uses, such as, for instance, commercial uses or workshops. The new ground floor covers now a larger area, bringing the façade closer to the public realm. Large windows reconfigure the relationship with the street domain to form a more open interface, promoting the commercial activity of the interior space.

Figure 55. Chapel Market, Islington – terraced house façade alterations.

Chapel Street is an example of how the flexibility of the terraced house exceeds beyond the building unit per se. In the sections of the urban grid where spatial circumstances attracted higher levels of socio-economic change over time, the flexibility of the terraced typology is extended to the whole row, to the block front as an aggregate of organisationally consistent building units. An underlying morphological rhythm organises the floor plan configuration and the building façade. This rhythm is then maintained and emphasised across the block front by the repetition of building units forming the block aggregate.

In this type of block configuration morphological *changes* are found frequently to follow this implicit rhythm; even in a case where a whole building unit has been replaced, the repetition of the plot at the same size maintains organisational references to the whole row. In such urban blocks, where the spatial organisation passes on the morphological features of both the parts and the whole, urban change can be absorbed by the built form, whilst maintaining a morphological consistency at various scales. This means that one building unit or many may change, in the same or in different ways, whilst still preserving a morphological unity across the block front. In turn, it is clear that a range of potentials for change occurs within such complexes. As seen in the case of Islington, change can range from an alteration within a row up to a trend of modification seen in the whole block front.

Moreover, in terraced urban complexes, morphological consistency can pass on to building types other than the terraced house itself. Zooming in to Upper Street we find an example: the four-storey building at 133 Upper Street, built originally as a school and occupied today by shops on the ground floor and offices in its upper floors (Figure 56). On the five-window width of the long-standing façade (built in the early 19th century), a central horizontal zone is marked by the round-arched entrance (the former school entrance). At either side of the

Figure 56. 133 Upper Street, Islington.

doorway pilasters, the ground floor interface – in its current form – is covered by large windows which exsect the stucco façade to expose the commercial interiors. The subdivision of the ground level into two commercial units, with two horizontal zones of window casements aligned above each unit, approximate the façade size and morphological organisation of a typical terraced building. In other words, 133 Upper Street began its life cycle as an educational building, larger in size than a private terraced house, but still the morphological rhythm of its façade took into account the organisational properties of the terraced complexes. Thus, when the larger unit was required to accommodate a new functional purpose, it was possible for its subdivision to occur without losing the part-whole morphological references of its architecture to the historical urban block.

Bringing together a comparative overview of historical business directories for Chapel Street in different years allows us to form an understanding of the high frequency in which shifts in building function and occupation may occur during the processes of urban growth. This brief historical flashback offers an example of the responsive flexibility shown by the terraced building volume. The case of Chapel Street confirms the ability of the terraced typology to respond to shifting socio-economic requirements over time, both as a single building unit and as part of the terraced row. The parts-whole morphological consistencies allow for urban change to occur within a wide range of variations and at various scales, meaning that transformations present a purpose-fit character.

Whilst on the one hand there are districts within the urban streetscape where change has been assimilated by the existing built form, and where street liveliness has been multiplied over time, (as in the case of Chapel Street), on the other hand there are areas facing decline and which fall time after time into loops of both morphological and socio-economic inertia. In closing, this chapter examines different conservation areas looking at the 'image of the streets' – stemming from the hypothesis that the image of varying street qualities is associated with marked differences in the properties of the street network and built form. The main inquiry is to establish whether there is any implication for a spatial logic in patterns of urban change.

5.5. Urban conservation and urban change

This section visits different urban districts of the case study area in order to explore the role of street network and built form properties in generating varying urban socio-spatial histories. Since 1969, the Council of Islington Borough has designated a series of urban ‘conservation areas’ around Upper Street with the purpose of guiding future development within the borough without compromising the historical qualities of its urban past. It is of interest to cite the Council’s formal description of the notions and context entailed by the term ‘conservation area’:

> *‘A conservation area is an area of special architectural or historical interest, the character or appearance of which it is desirable to preserve or enhance. Conservation areas are identified and designated by the Council. […] The special character of these areas does not come from the quality of their buildings alone. The area as a whole, including historical layout of roads, paths and boundaries; characteristic building and paving materials; a particular 'mix' of building uses; landscape and tree cover in public and private spaces all make up the familiar local scene. […] Conservation area designation is a way of protecting these special parts of the borough and ensuring that any new development is sensitive to their historical character.’*

From this description a number of interesting points arise. The text highlights the basic acknowledgement that built form itself is not the sole factor defining an area’s *character*. In fact, street layout, components of the streets’ micromorphology (i.e. the architectural treatment of the pavement at the level of individual plots), building uses and their mixture, as well as the intermingling of private and public spaces, are all considered as parameters that have an impact on the identity of urban sceneries. Working within a relevant framework, the discussion in sections 5.3 and 5.4 focused on an investigation into the way particular urban features each influence the formation of varying street interfaces at the level of the ground floor. More specifically the analysis discussed the role of street network, land uses, building-street thresholds, and the morphological properties of the built form, based on building types. In an effort to consider all these factors together, this last analytical section assesses whether areas with different socio-economic profiles present notable differences in their spatial histories and morphological properties.

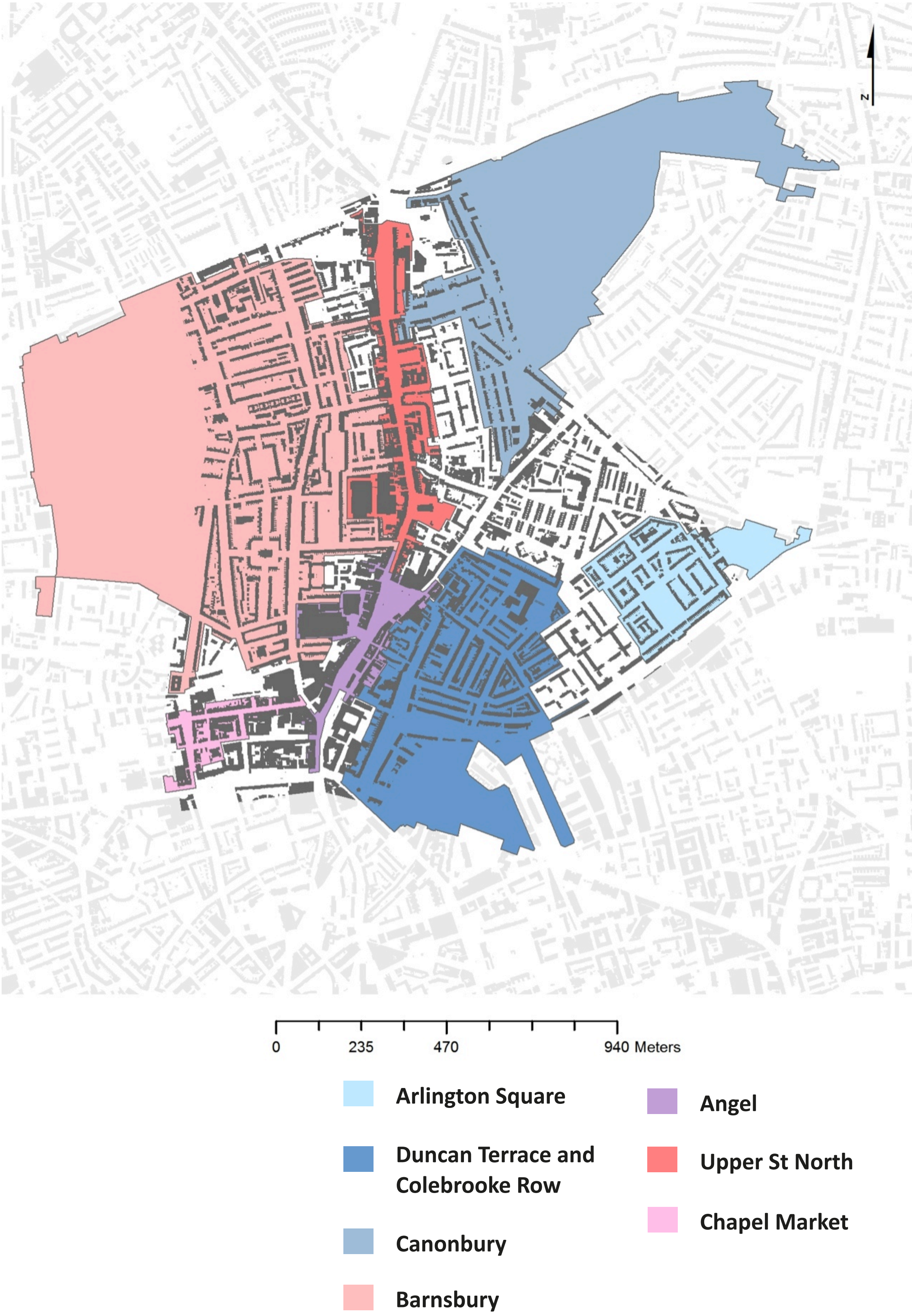


Figure 57. Islington, London – conservation areas. (c.2013)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

There are seven conservation areas falling partly or wholly within the case study boundary (see Figure 57), with all areas having been designated at different points in time:

- *Arlington Square*, designated 7 January 1969;
- *Duncan Terrace and Colebrooke Row*, designated 7 January 1969;
- *Canonbury*, designated 18 February 1969;
- *Barnsbury*, designated 1 April 1969;
- *Angel*, designated 28 April 1981;
- *Upper Street North*, designated 4 July 1985; and
- *Chapel Market*, designated 21 March 1991.

Analysis in the following paragraphs compares the varying profiles of these areas. At the same time, a comparison is drawn between streets falling within a conservation area with those not defined as such.

5.5.1. The conservation areas

The discussion here provides a brief overview of the main streetscape characteristics for the conservation areas and Figures 55-61 summarise the profile of each listed area in terms of land uses and building types.

Arlington Square (Figure 58), along with Duncan Terrace and Colebrook Row (Figure 59) were the first urban districts around Upper Street to be protected by conservation guidelines. Designated as conservation areas as early as January 1969, streets in these districts maintain their historical built form unity and architectural features (91% of façades in Arlington denote early Victorian terraces; 86% of terraces in Duncan Terrace and Colebrook Row are in Late Georgian and early Victorian style). Canonbury, on the other hand (Figure 60), presents both a different topography – moving away from Upper Street one finds lower building densities, detached houses, and open fields – and a greater mixture of building types than the two previous cases (68.5% of building façades are terraced houses, 5.6% are villas and 13% are council housing units). Barnsbury is the largest conservation area of all and was historically built up with middle-class terraces (78.3%; Figure 61). All cases mentioned so far have a predominately domestic profile and form part of the background city network.

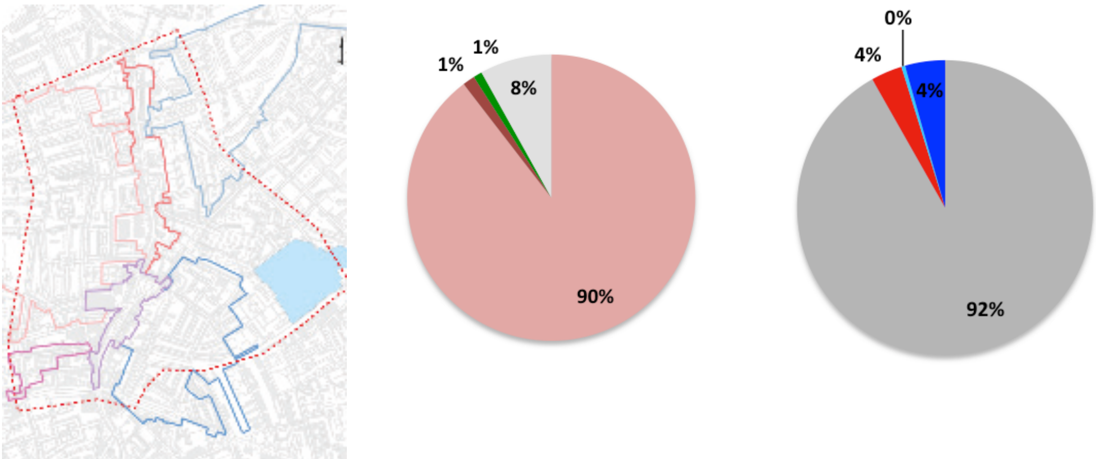


Figure 58. Conservation area: *Arlington Square*, Islington.

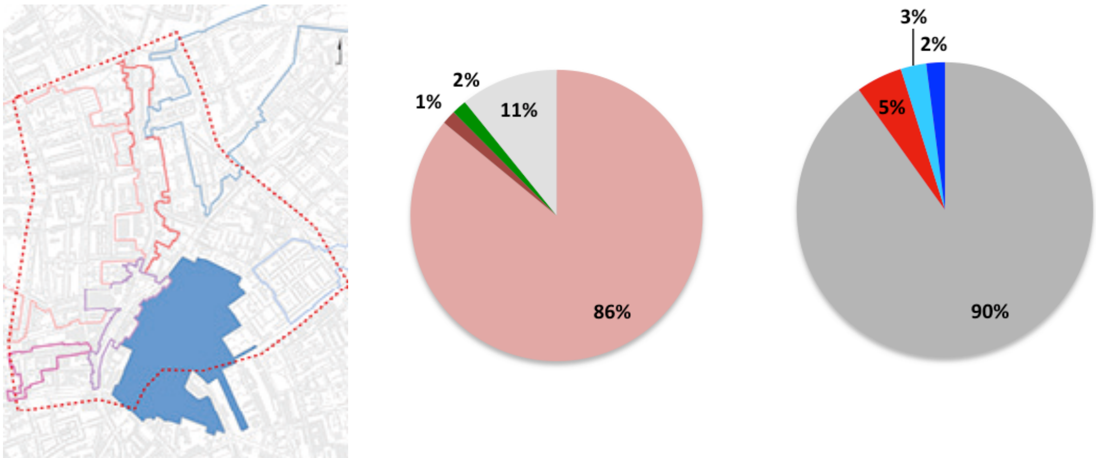


Figure 59. Conservation area: *Duncan Terrace and Colebrooke Row*, Islington.

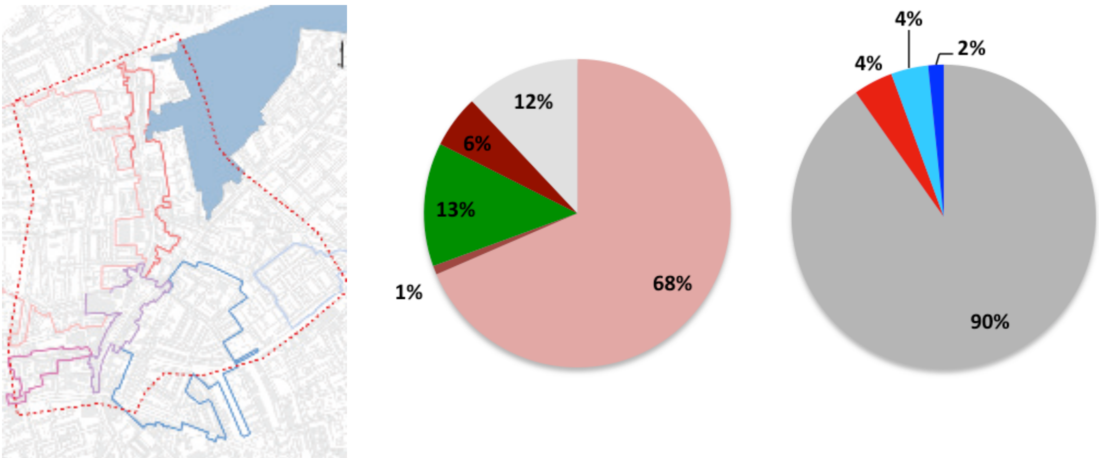


Figure 60. Conservation area: *Canonbury*, Islington.

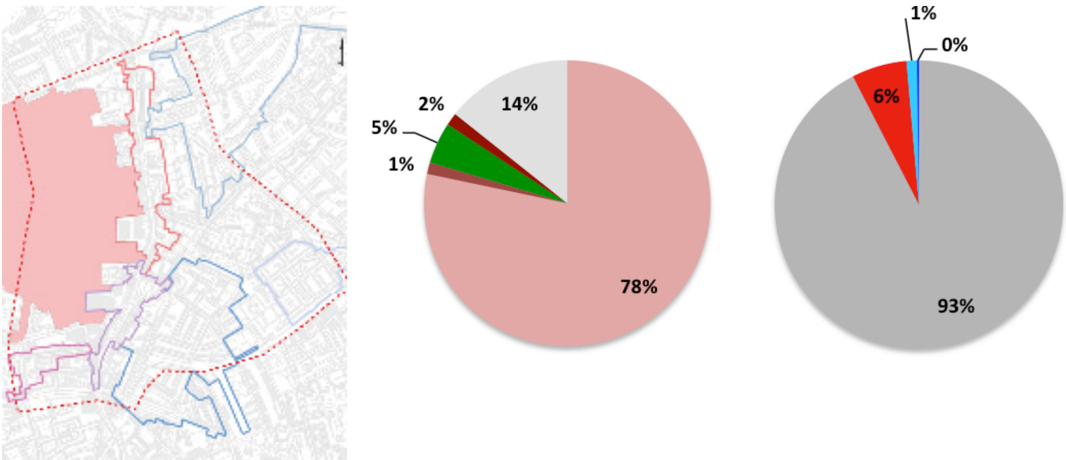


Figure 61. Conservation area: ***Barnsbury***, Islington.

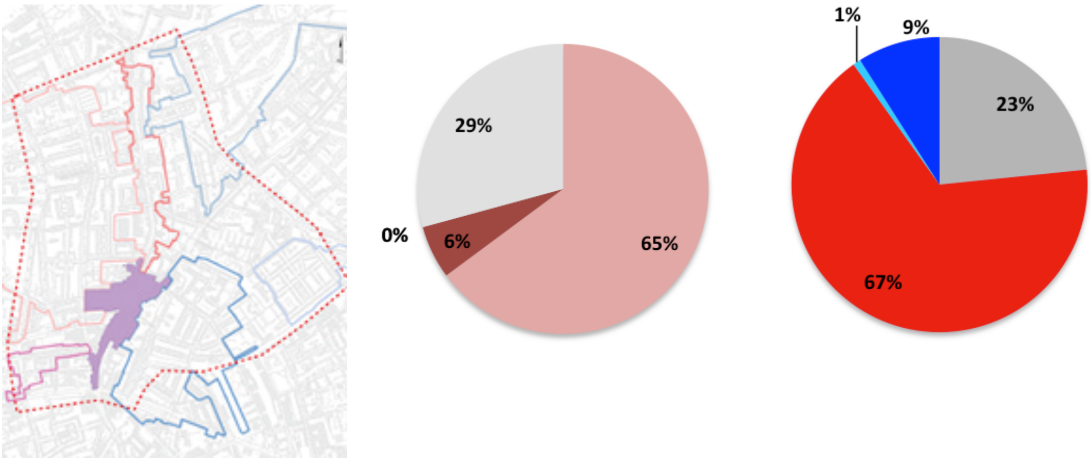


Figure 62. Conservation area: ***Angel***, Islington.

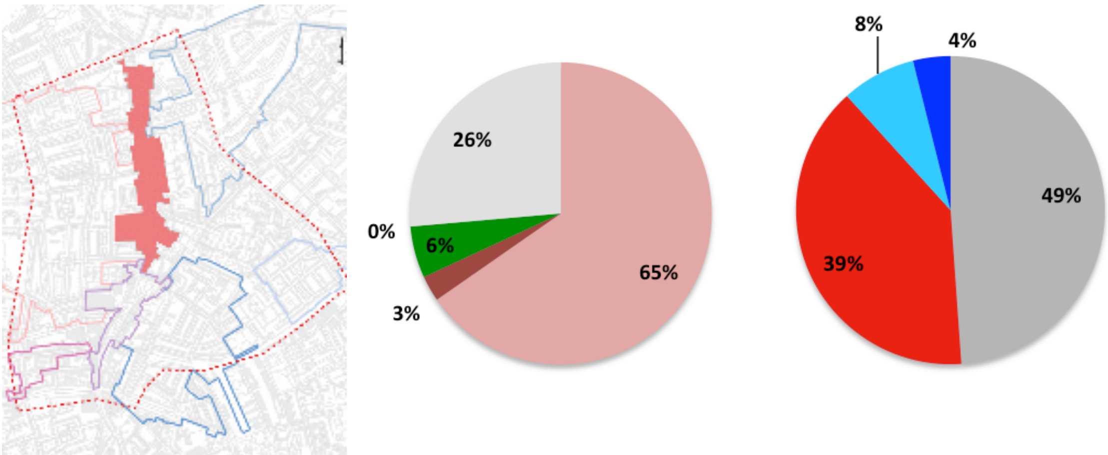


Figure 63. Conservation area: ***Upper Street North***, Islington.

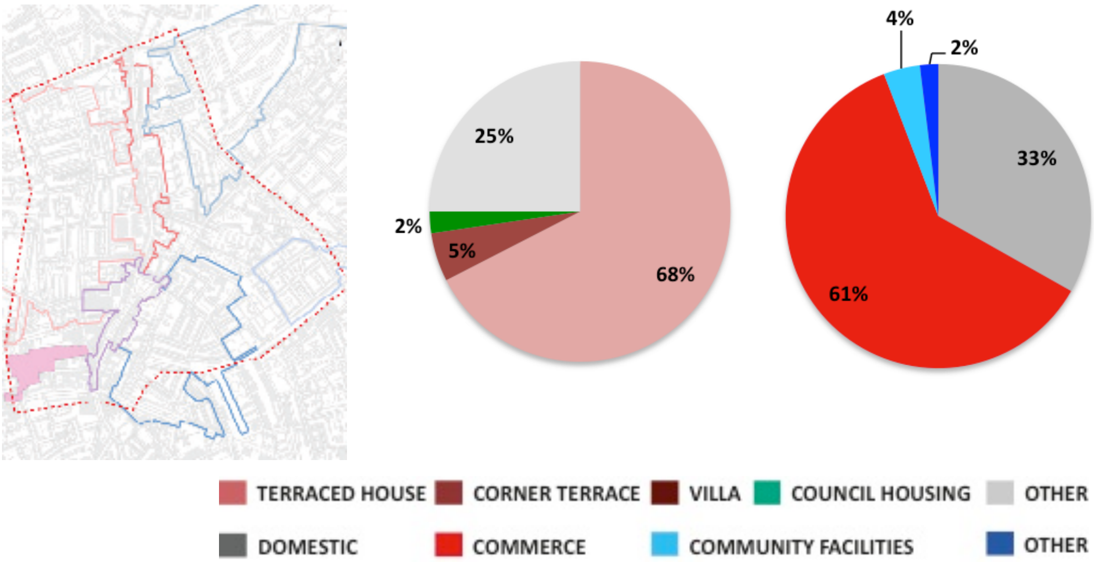


Figure 64. Conservation area: *Chapel Market*, Islington.

The three remaining conservation areas are located more centrally within the case study area and the city grid in general. Angel and Upper Street North, designated in the 1980s, cover the length of Islington High Street and its branch, Upper Street (Figures 62 and 63). The last and most recently designated conservation area is Chapel Market (formerly Chapel Street) which is part of Pentonville[39] and was extensively discussed in the previous section (Figure 64). In contrast to the previously mentioned conservation areas, these latter districts either form part of the foreground city network, or lie in close proximity to foreground city routes. It appears that urban change has here affected to a greater extent the architectural unity: these areas present the lowest percentages of terraced houses amongst the conservation areas studied (64.8% for Angel and 65.3% for Upper St North). In addition, Chapel Street presents the highest recorded number of altered terraced façades in the case study area (see earlier in Figures 53 and 54).

[39] The fields at the north side of the new road from King's Cross to the Angel developed in 1780s. The estate was named after its developer, Henry Penton.

These conservation areas, then, differ in their densities of building-street connections, in their levels of mixture in uses, and varying numbers of surviving historical buildings. By examining each, it can be seen that the individual character of an urban place is shaped by the historical interplay between a variety of factors – the area's spatial properties (street network), its physical properties (built form) and its related socio-economic function – in which time acts as a generator of multiplier effects. Observations indicate a relationship between these factors: each influences another, as well as the area profile overall. Results show that differences in the spatial and physical properties reflect the socio-economic functioning of urban places, and vice versa. Figures 65-67 (see the relevant tables in Appendix, A5) illustrate the recorded differences presented together in order to facilitate a comparative overview.

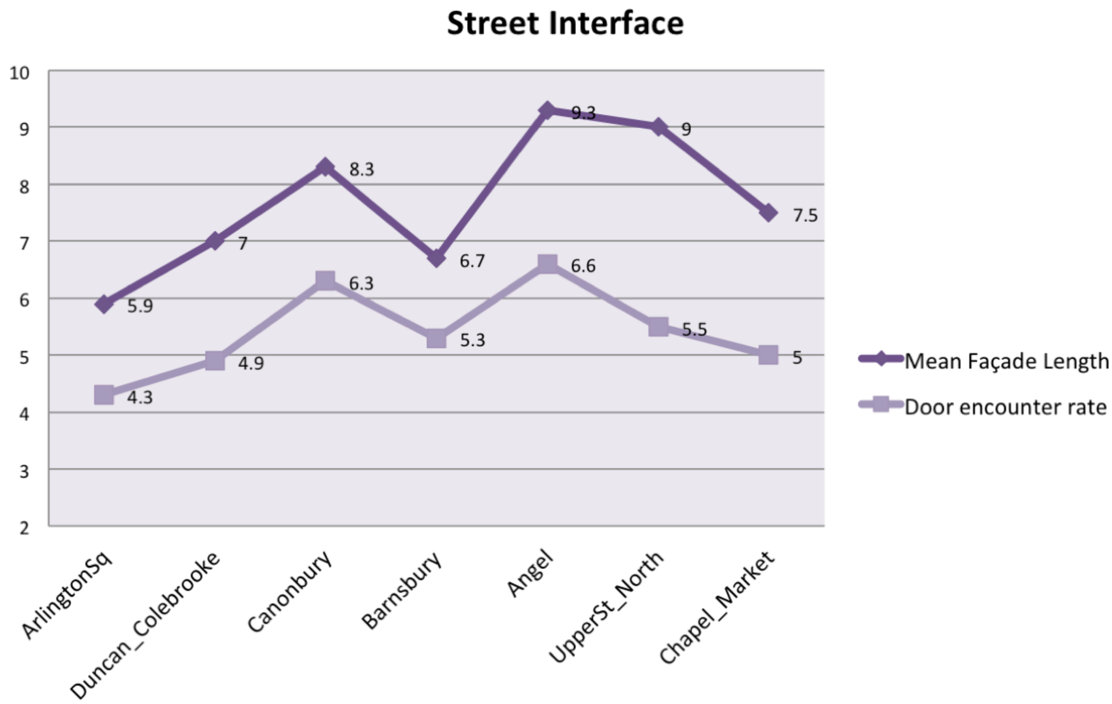
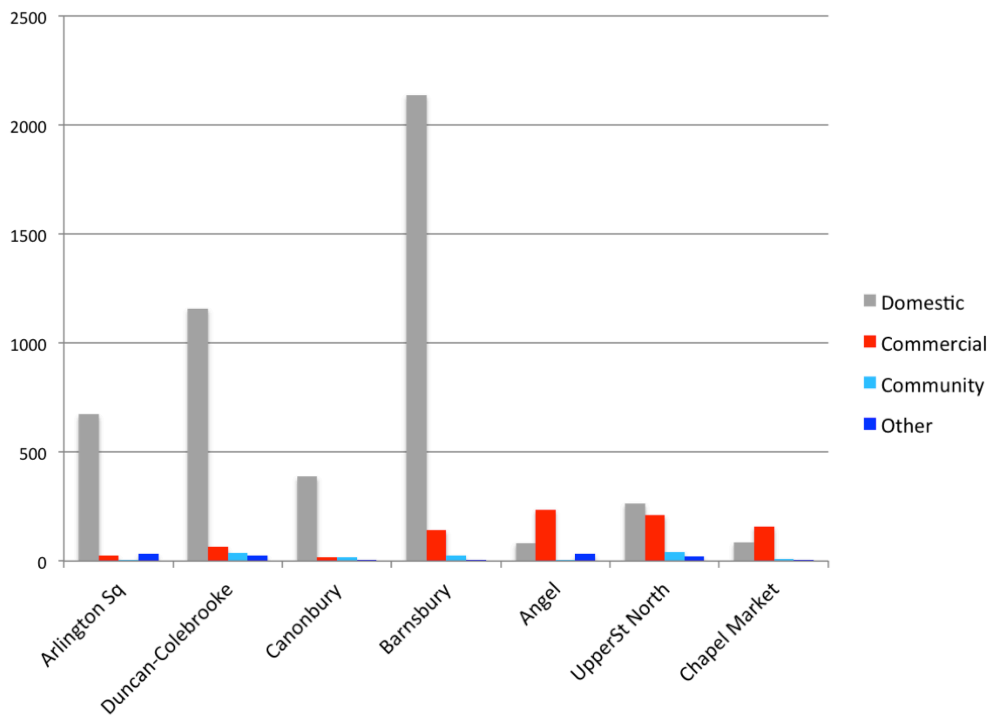


Figure 65. Conservation areas: *street interface.*

CONSERVATION AREAS



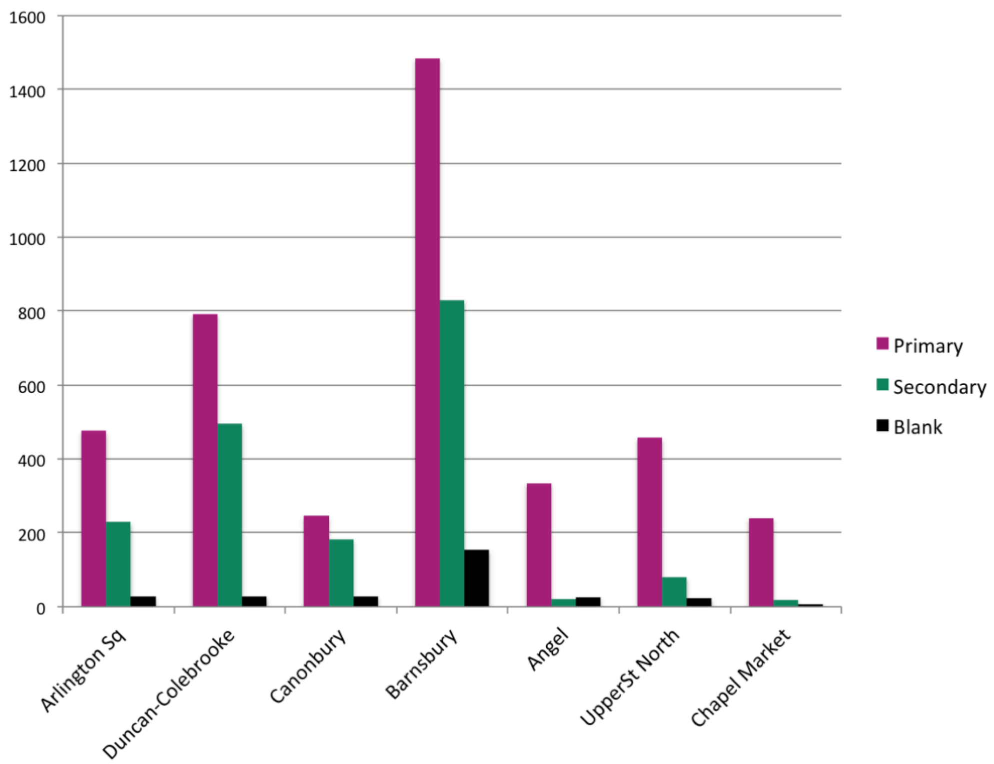
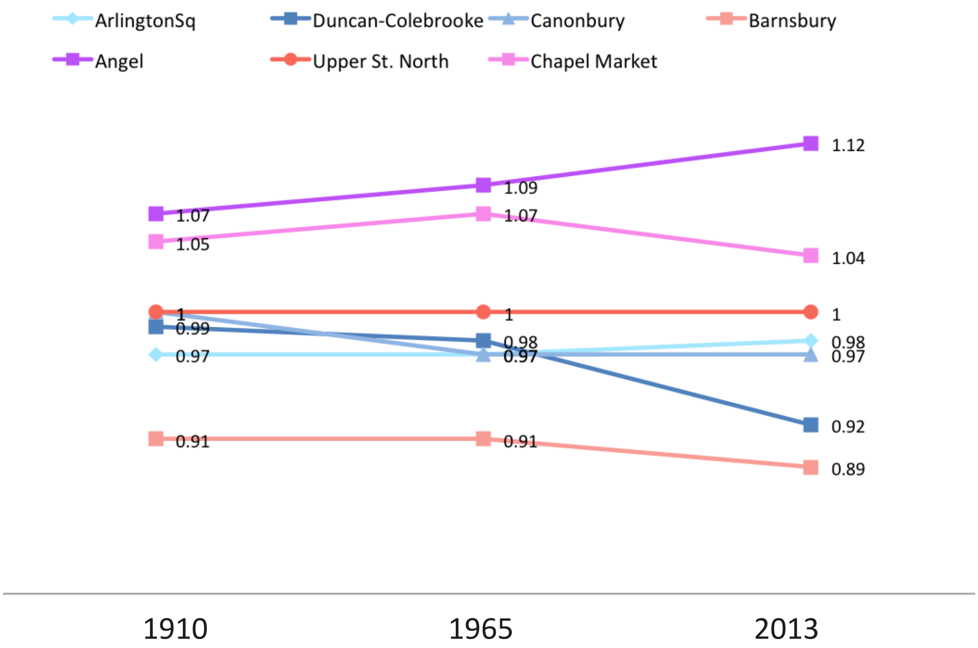


Figure 66. Conservation areas: building thresholds; *function* (top) and *type* (below).

CONSERVATION AREAS



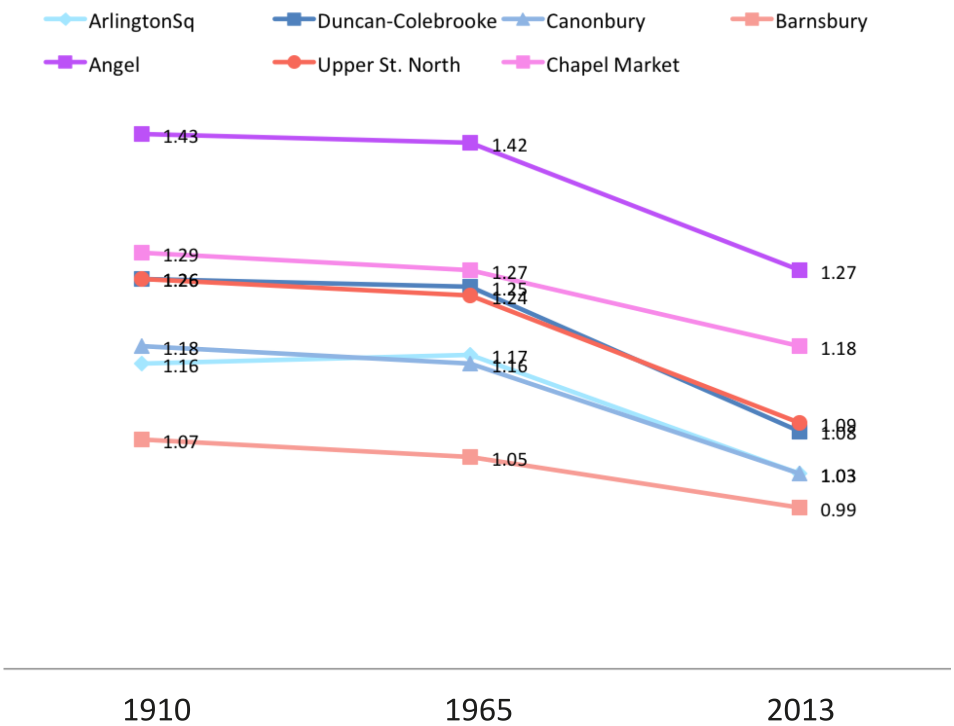


Figure 67. Conservation areas: street network properties; the *normalised* measures of *choice* and *integration* for c.1910, 1965 and 2013.

The results in Figures 65-67 confirm once again a relationship between the properties of the street network and the areas' profile in terms of the supported socio-economic activities. The areas with a predominately commercial character present correspondingly the highest values in both *normalised choice* and *integration* over time (Angel, Chapel Market and Upper Street North – ordered starting from the one with the highest percentage in commercial uses and respectively the highest mean syntactical values for radius 2500 meters). However, the scale of commerce changes for Angel and Upper Street North, which both form the alignment of the main historical thoroughfare, in comparison to Chapel Market, where small commercial-residential terraces prevail. It can be seen, then, that in addition to the properties of the network and an area's socio-economic functioning, the properties of the built form itself contribute to the shaping of varying streetscapes. Here, the study examined in particular the building façade length and the density of building street entrances aggregated on block fronts. In general, results indicate a relationship between the building façade length and the door encounter rate (Figure 65); the areas with wider building façades present a looser street interface, while narrow buildings enable more frequent interior-exterior/private-public encounters. Depending in turn on the land use allocation and building functions[40], the type of the building-street interface – primary or secondary – is another factor that produces diverse street micromorphology at the ground floor level (Figures 66 and 67).

An interesting question arises at this point; this refers to historical processes and the degree and type of urban change observed in the various locations of the city grid. Since we can observe recorded differences in the spatial properties of street sections followed by variations in land uses and their mixture, which in turn configure the micromorphology of the street interface, the next step is to ask whether there is anything inherently spatial that renders urban districts more or less prone to change; and subsequently, whether there is a *diachronic spatial logic* to the probabilistic encounter field.

[40] See the discussion earlier in Section 5.3.2 regarding the relation between the type of interface and the building function.

5.5.2. A glance at the past

This section takes a first step in addressing these questions, seeking indications that might relate the socio-spatial history of a place to its spatial and built-form properties. At the same time, this comprises an introduction to the topics discussed extensively in the next chapter. The following paragraphs look at the image of the streets *historically*. More particularly, the discussion relates the configurational properties of the historical street network with historical descriptions of the profile of the streets. This analysis of the historical street network uses syntactical segment maps created by the author for the purposes of this research. Segment maps for c.1910, 1965 and 2013 were drawn based on the relevant Ordnance Survey maps, encompassing a radius of 3 km around the case study area. Figure 65 shows these syntactical maps superimposed on Charles Booth's *Maps Descriptive of London Poverty, 1898-9*.

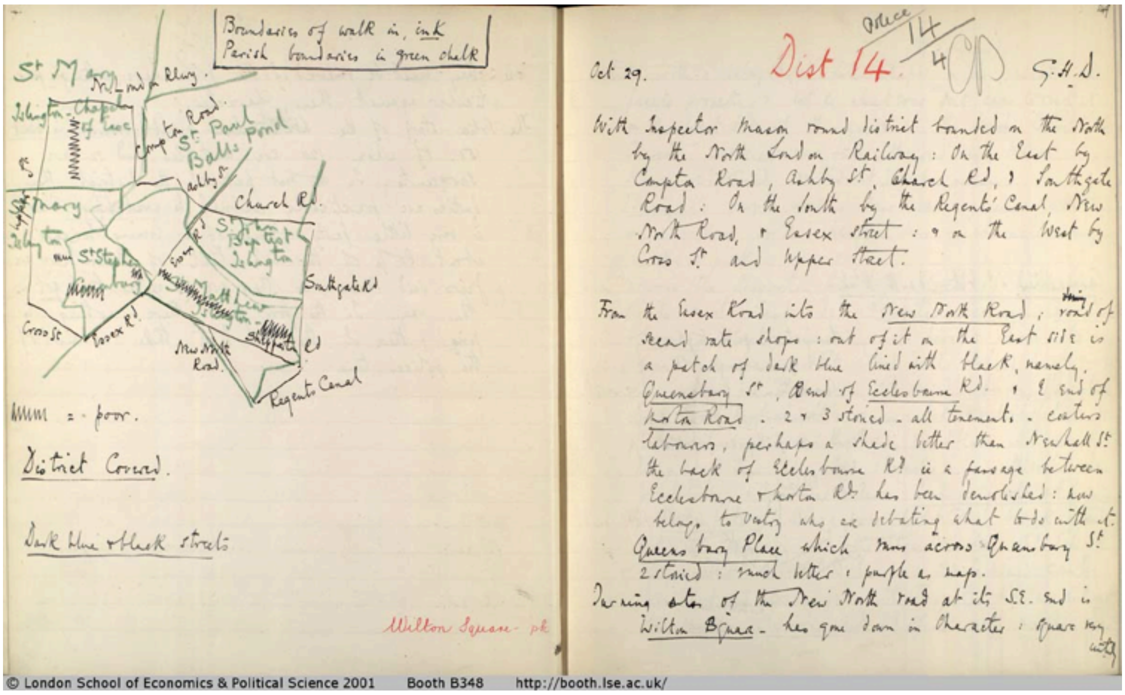
Even at a first glance at this comparison, several observations can be noted. It appears that the blue parts (which indicate poor inhabitants for buildings) in Booth's map coincide with segments of the street network that were historically more spatially segregated (Figure 68 shows in particular the measure of *combined integration and choice* for radius 2500 meters). In order to retrieve an essence of the past profile of Islington's streets, the study also turns to Charles Booth's descriptions as recorded in 1897 in the *Notebooks* of his study assistants, who accompanied local policemen on their beats in order to determine whether the working and living conditions of local inhabitants had changed at all since his 1889 survey[41] (Figure 69).

[41] From Booth's Notebooks, District 14 (visited on October 29th, 1897) and District 15 (November 11 and 15th, 1897) refer to the urban blocks around Upper Street, namely the case study area here. A transcription of these extracts was provided from the personal archive of Professor Laura Vaughan, who has performed extensive research on Booth's poverty maps (see for instance: Vaughan, 2008; Vaughan and Geddes, 2009).

Background map: Charles Booth map © Courtesy of Prof Laura Vaughan, LSE and EPSRC | *http://booth.lse.ac.uk/*

Figure 68. Historical street network and Charles Booth's classes of poverty.

Showing segment angular analysis for the measure of *combined integration and choice*, radius 2500 meters, for c.1910, 1965 and 2013 superimposed on Charles Booth map.



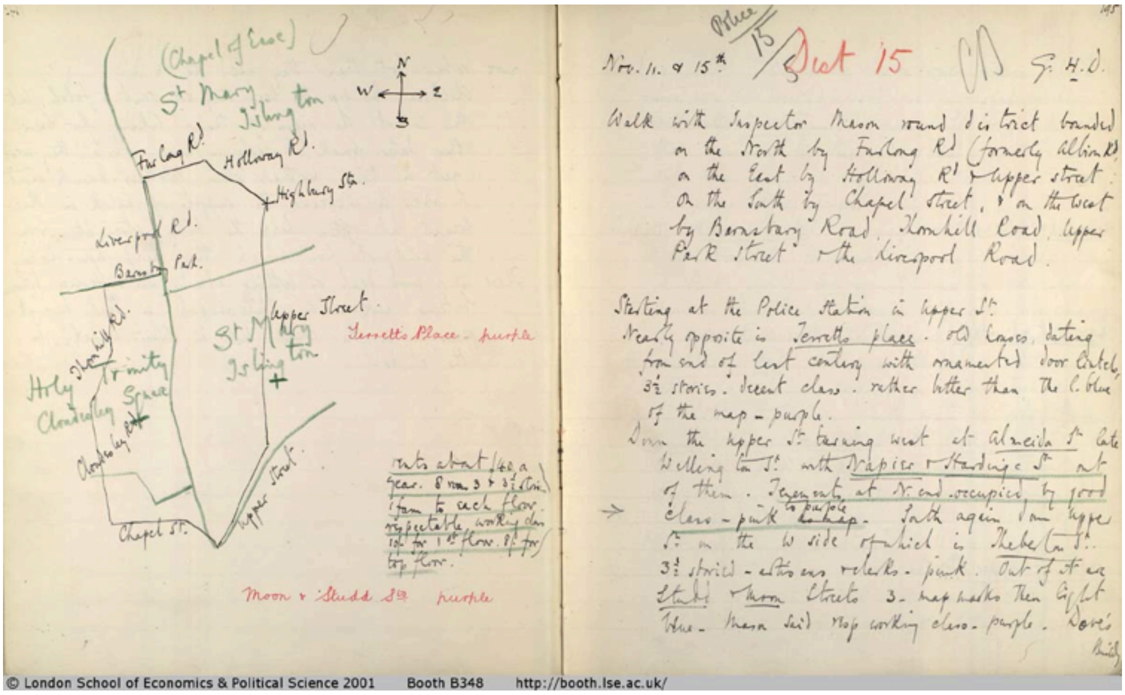


Figure 69. Charles Booth Notebooks: Islington, London, c.1898-9.

http://booth.lse.ac.uk/

The notebooks indicate the relevance of a place's location within the city grid in its chances for decline or prosperity. For instance, Booth's investigator notes on accessibility:

> *'North of the Board School on the east side of Canonbury Road is a nest of small courts with one or two storied houses. Carters Yard, Compton Mews, North & Friends Cottages. Respectable working class but once a bad family got in would rapidly become a slum of the worst sort, shut in all round: difficult of approach.'* (District 14)

In District 15 a relative example is brought up, where comments refer to the effect of integration on less accessible surroundings (a phenomenon called in syntactical terms 'marginal separation by linear integration'; see Hillier, 1996, p.52):

> *'Then north into White Lion Street as map through Warren Street into Barnsbury Road. Some brothels in the back streets off the main road "you will always find them in one or two of the quiet streets off the public thoroughfares in any part of London you go to!".'* (District 15)

At the same time the investigator locates areas which appear more susceptible to decline, while other locations near the historical thoroughfare seem to have a more fortunate outlook:

> *'Starting at the Police Station in Upper Street. Nearly opposite is Jewetts Place. Old houses. Dating from end of last century with ornamental door lintels, 3½ stories. Decent class. Rather better than the light blue of the map – purple.'* (District 15)

In order to examine in greater detail the current streetscape in relation to Booth's classification, each segment of the c.2013 syntactical map is assigned with Booth's classes of poverty.[42] This is based on a methodology suggested by previous space syntax studies on the historical relation of street network and areas of deprivation,

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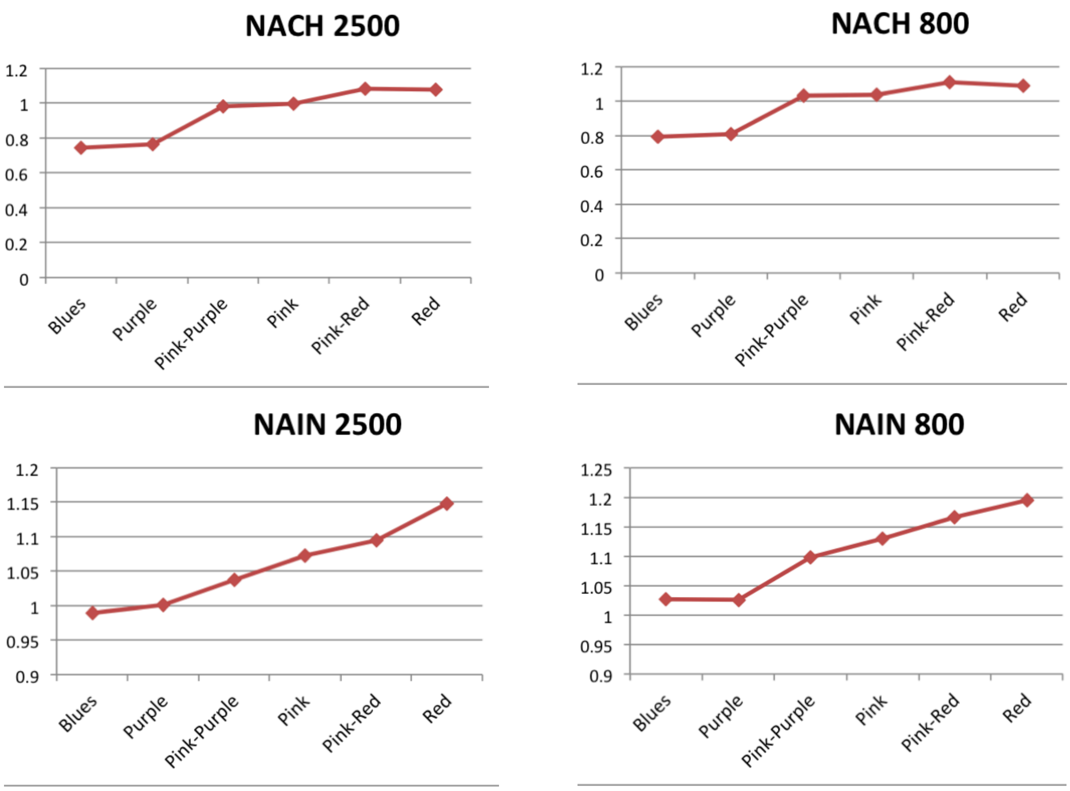
[42] Within the case study area here, the following colours occur in Booth's map: red, pink, pink-red, pink-purple, purple, light blue, dark blue. These are also some segment sides that are occupied by buildings in different classes, giving combinations such as light blue-pink, dark blue-light blue etc. These combinations are not part of Booth's formal colour legend, although this greater level of detail is explained in the volumes accompanying the maps as providing a higher degree of accuracy in classification.

using as a starting point Booth's classification (Vaughan et al., 2005a, 2005b; see also Vaughan, 2007). The methodology is applied here in order to investigate whether there is any pattern of correspondence between the distribution of poverty and the street configuration in the case study area – in line with the methods used by Vaughan et al. in their research on 'Space and exclusion' (2005a). However, here the inquiry differs in its focus in tracing the relationship between spatial configuration and patterns of built form change.

Indeed, when comparing average syntactical values for each of the classes mapped by Booth within the case study area[43], a relationship between the street configuration and the historical socio-economic status of the area is revealed. The charts in Figure 70 show the mean values for the measures of *normalised integration and choice*, calculated both for the wider Islington surroundings (radius 2500 meters) and for the local surroundings of Upper Street (radius 800 meters). The mean values appear to systematically increase with economic class (namely, as Booth's colour range turns from cooler to warmer colours). This result is consistent both for integration and choice values, and for both radii as well.

Evidently the economic status of a building's inhabitants does not necessarily imply a more or less sociable street interface. Rather, this observation relates to the degree of change to which the built form is likely to be subjected over time. In a historical account of Islington's growth provided by *British History Online*[44], it is mentioned that major redevelopment projects were instigated in the area when in the 1860s the pressures for slum clearance and the provision of working-class housing became imperative. Indeed, these projects began by addressing urban blocks which still appear marked in the blue colour range in Booth's poverty map, such as the blocks between Britannia Row and the Peabody Square (later the Peabody Estate). Effectively, those urban districts where the historical built form has not survived were those not protected by conservation guidelines. Charts in Figures 71 and 72 confirm the consistencies between Booth's classification; the street sections which today fall within conservation areas – namely the streets where the historical built form has sur-

[43] For the purposes of this analysis the three poverty classes are grouped together as 'blues', to avoid an excess of small sub-categories.
[44] http://www.british-history.ac.uk/report.aspx?compid=6734&strquery=islington >



On the left, Booth's poverty classes as described on the legend to the maps.

http://booth.lse.ac.uk/

Figure 70. Islington, London – street configuration and Charles Booth's classes of poverty.

Charts illustrate the mean values for the *normalised* measures of *choice* and *integration* for Booth's different poverty classes (colour range).

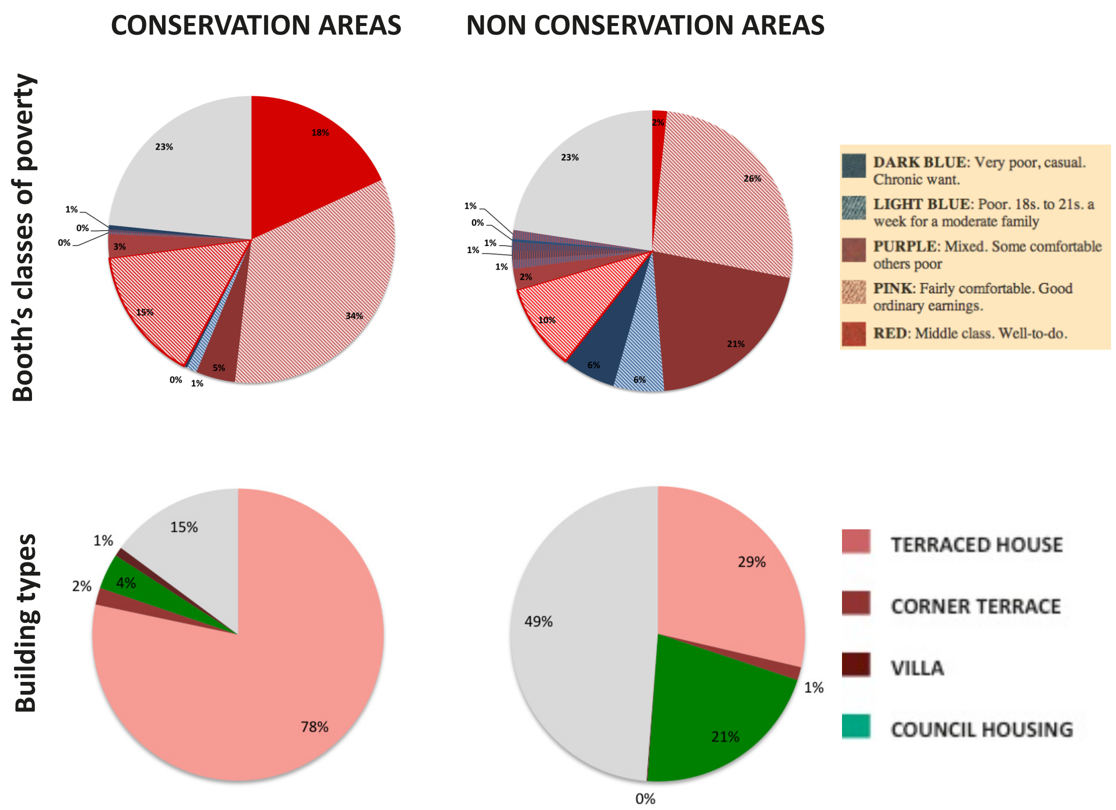


Figure 71: Booth's classes of poverty and building types.

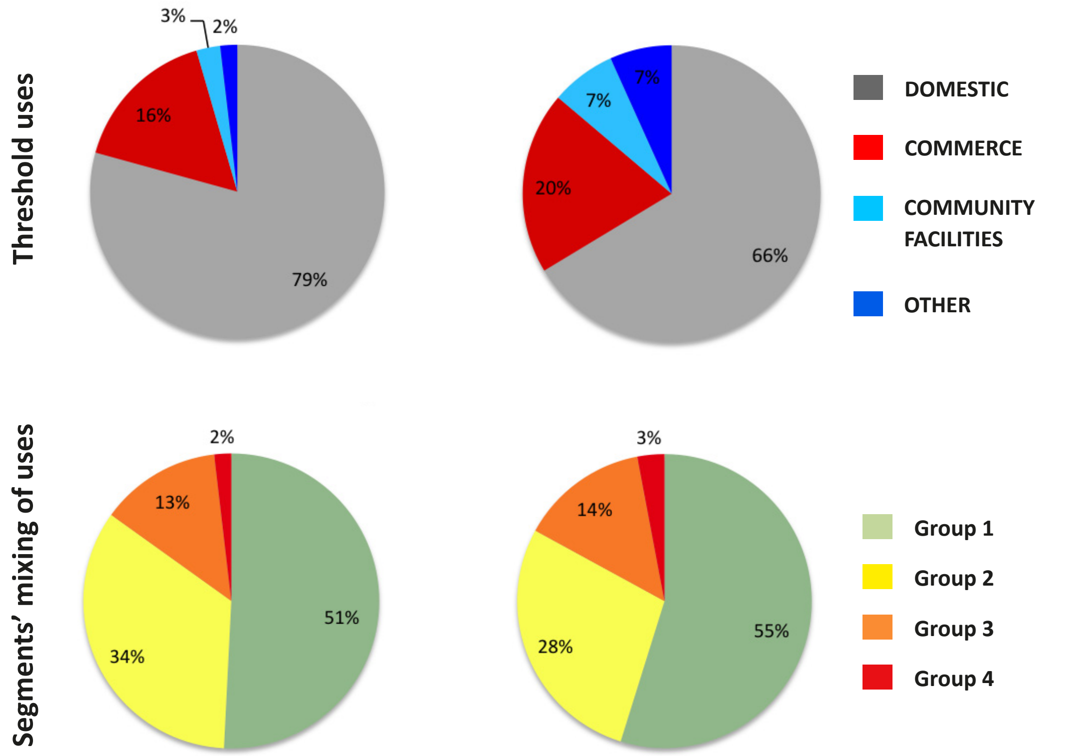


Figure 72: Threshold uses and segment scale mixing of uses.

vived; and the existing building types within conservation and non-conservation areas of the case study area. Notably, in non-conservation areas the presence of council housing is five times higher (21%) than observed in areas protected by conservation (4%). This, in turn, brings us to the properties of the street interface. The higher presence of terraced houses – namely, the higher presence of buildings with narrow façades – implies a street interface denser in building thresholds; on average, the door encounter rate for conservation areas is 5.2 meters, while in non-conservation streets a door would be expected every 8.4 meters.

Whilst thresholds in conservation areas are predominantly domestic, exceeding by 13% per cent the domestic thresholds in non-conservation areas, at the same time conservation and non-conservation areas present on average very similar percentages in terms of land use mixture per street segment (see charts in Figure 72). This is surprising considering that non-conservation areas have a higher percentage of non-domestic uses. However, this result implies that in conservation areas the domestic use is interspersed with non-domestic uses (especially with commerce; segments classified as 'Group 2' – medium low – level of land use mixing) to a greater extent than in non-conservation areas, leading to greater mixture at the segment level. A diversity of land uses, in combination with density of thresholds, means effectively a higher potential for a diverse micromorphology of dense probabilistic encounters at the street domain.

User co-presence is also intensified by the effect of the street network. While the measure of *normalised integration* shows a relative consistency between conservation and non-conservation areas over time, the syntactical values for *normalised choice* show that conservation areas maintain a higher and steadier centrality within Islington's surroundings than non-conservation areas. Higher values for the measure of *choice* are interpreted by space syntax theory as a higher potential for the *through movement* of pedestrians, and thus greater chances for mixing between the users of the local area and users of the wider city surroundings (here calculations refer to a radius of 2500 meters around each street within the Upper Street area) (Figure 73) – a spatial characteristic which was highlighted by Hanson (2000) regarding street liveability (see also Legeby, 2013).

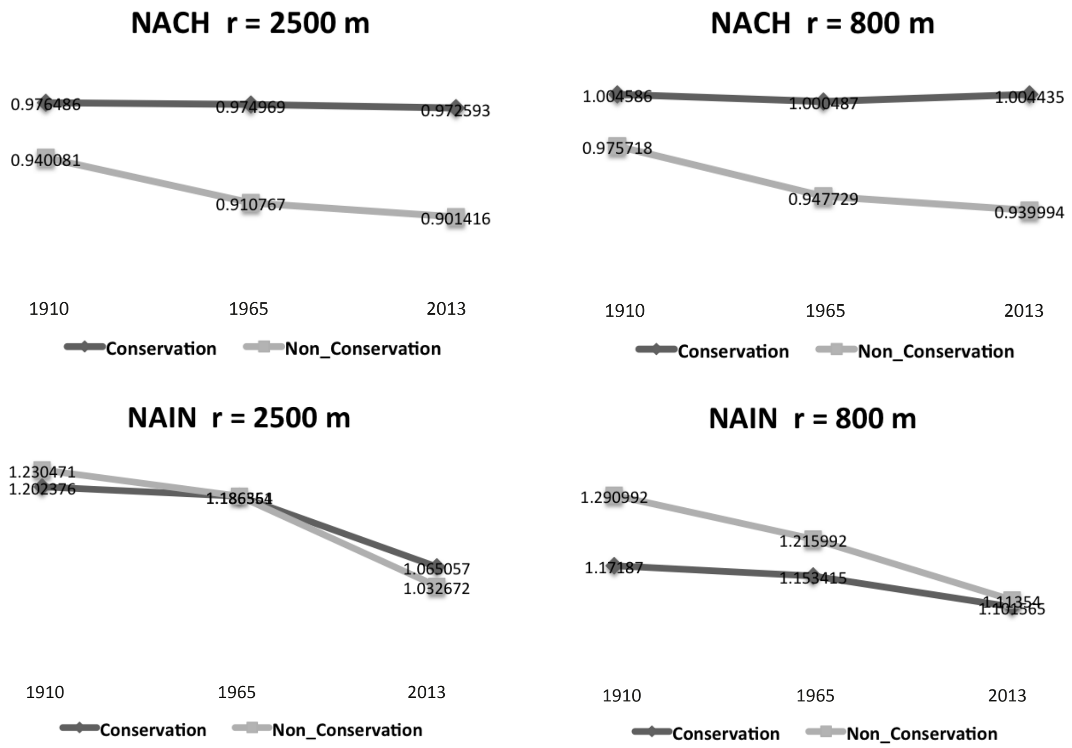


Figure 73. Islington, London – conservation areas v. districts not protected by conservation.

Charts illustrate the mean values for the *normalised* measures of *choice* and *integration* c.1910, 1965 and 2013.

Overall, this last passage of the first analytical chapter aimed to explore whether patterns of urban change follow a spatial logic. This inquiry relates to the way the street interface is shaped over time – in terms of buildings and streets – and therefore to the probabilistic patterns of the virtual community. Temporal analysis of the street network properties for c.1910 and 1965 was applied in order to examine the diachronic processes that potentially play a role in the formation of varying spatial cultures over time. The study compared the spatial past and present of the streets with historical data about the socio-economic profile of street sections (Charles Booth's descriptions of poverty classes). Results reveal some marked differences between the streetscape sections that have been historically socio-spatially deprived (Booth Map, historical segment maps) and sections of some greater socio-spatial prosperity. These differences refer to the properties of:

(a) the street network, in terms of accessibility;
(b) the present built form, in terms of the surviving historical buildings and the density of the building-street interface; and
(c) the present land use distribution, in terms of the mixture of uses.

This analysis suggests that within the case study area urban change has left a far more extensive – or even occasionally radical, with building demolitions – impact on the built form in some urban districts than others. These areas are found to be historically the poorest, and are located in less prominent locations of the street network – namely, the areas that were in poverty in the past were found to remain over time disadvantaged in their spatial accessibility. These street sections present nowadays differing density of building-street interface and building mix, in the sense that building thresholds appear sparser and less diverse in terms of use. The fact that the pre-existing spatially segregated state is markedly related to different street interfaces in the present indicates the potential role of the street network in the diachronic processes of the built form. Chapter 6 advances this research inquiry to understand: (a) whether/how: the historical shifts in the urban grid also play a role in shaping the micromorphology of the street interface; and (b) the role of building morphology in assimilating urban change and supporting potentials for a diverse micromorphology.

5.6. Islington: form follows grid

This chapter examined in great detail the streetscape of the area around Upper Street, in Islington, London. With the use of syntactical and morphological analysis the study explored the many factors that interact within the street domain, leading to the formation of varying street interfaces over time.

Bill Hillier has proposed that there is a generic city form that follows a 'deformed wheel' model, with a prominent network of spatially integrated streets in the foreground and quieter, primarily residential streets in the background[45]. This spatial model has been related by space syntax research to a variety of urban phenomena, such as the location of commercial activities, with marked consistency (Hillier, 1999a; 1999b). Chapter 5 contributes to this theory by investigating the way in which built form properties – and their associated land use and historical transformation – follow the socio-spatial logic of the street network, especially given the fact that Islington provides an example *par excellence* of this 'deformed wheel' model. Firstly, the study on Islington discussed the way street network and built form properties influence the materiality of the virtual community. Results indicate that *the urban grid structure impacts on the functional homogeneity or mixture of the street interface*, and hence to its potential for probabilistic encounters and co-presence. *Building morphology impacts on the density of building-street connections within the block front.* Secondly, the street network-built form relation was traced over time to look for indications of a spatially driven logic in urban change. Indeed, results indicate that *the urban grid structure impacts on the morphological continuity and change of the street interface.*

These indications are to be further explored in the next chapter, which applies the methods described here to a contrasting case of built form adaptability. Additionally, considering the historical flexibility in building adaptations demonstrated by the terraced house typology over time, a new query is raised for the analytical explorations applied in the streets of the West Village: *how can the built form afford and accommodate urban change in a manner that can sustain a probabilistic micromorphology?*

[45] See: Hillier and Hanson, 1984, p.115; Hanson, 1989, p.20; Hillier, 1989, p.10; Hillier and Vaughan, 2007, p.217.

6A

Chapter six - The West Village, Manhattan

(Part A)

> *'Of the Historic Districts in New York City which have been designated or will be designated, Greenwich Village outranks all others. This supremacy comes from the quality of its architecture, the nature of the artistic life within its boundaries, and the feeling of history that permeates its streets.'* Greenwich Village, Historic District Designation Report, 1969, Vol. 1, p.7.

6.1. Introduction

This chapter will examine the interplay between the street network and built form in an urban setting far more challenging in terms of urbanisation processes than the case of Islington. The West Village was selected as a case study for this research as it provides a wealth of examples of row house adaptations over time. The site is of importance for debates regarding urban liveability partly due to its longevity as a mixed-use residential neighbourhood and partly due to its association with the work of the writer Jane Jacobs. In 1961 Jacobs published her influential book *The Death and Life of Great American Cities,* a criticism of urban design and planning practices based on her observations and interpretations of urban socio-spatial phenomena. Jacobs lived in Hudson Street, in the West Village, and many of the experiences described in her book emanate from the case study area.

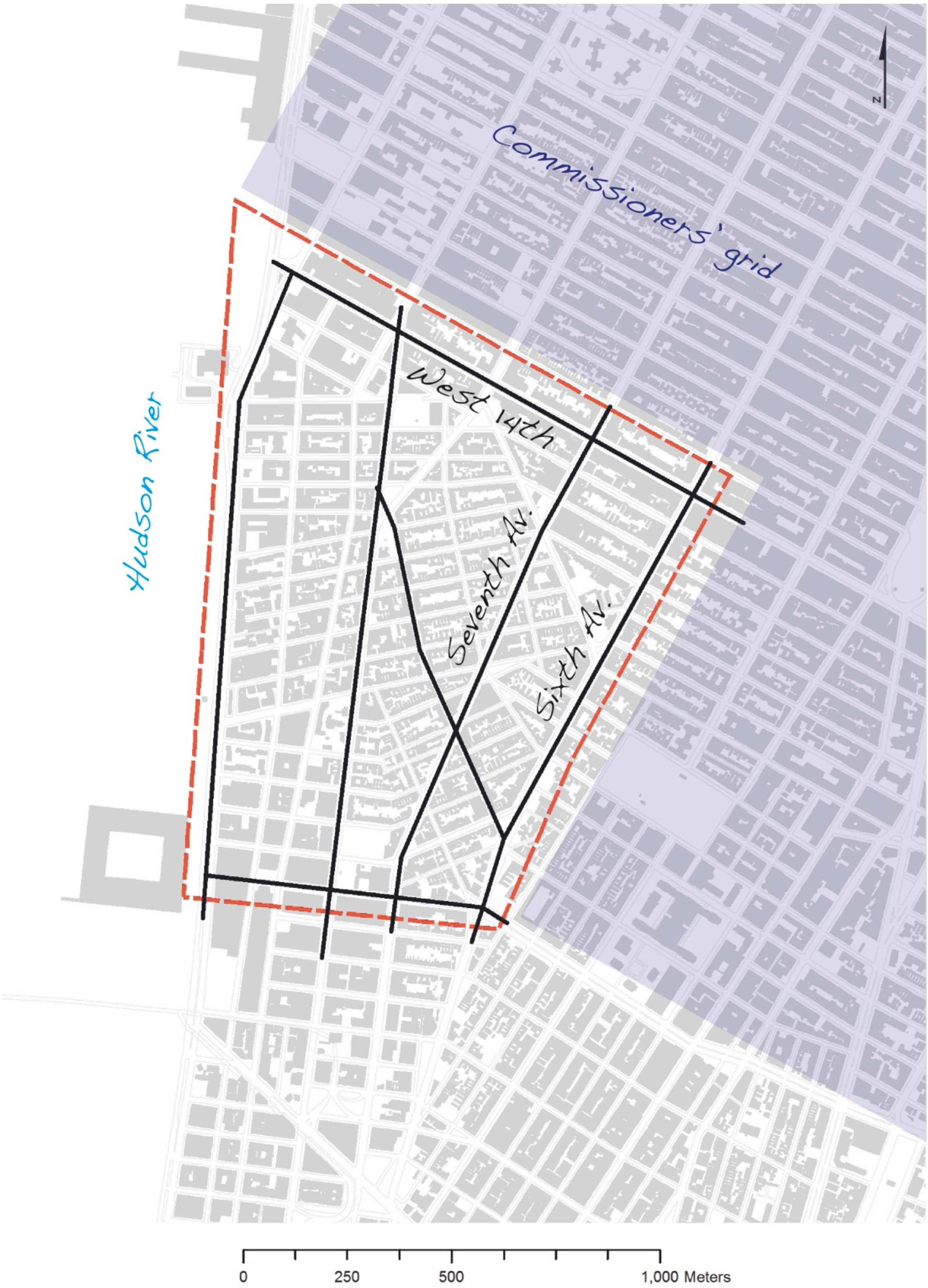


Figure 74. The West Village, Manhattan: case study area.

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

In an effort to examine street liveability at a generic level – namely, looking at the *micromorphology of the virtual community* – this study of the West Village, Manhattan (Figure 74) uses space syntax and urban form methods to record the changing micro socio-spatial texture of the neighbourhood. For Jacobs, the West Village, with its diversity and mixture, is a good example of street liveability. To examine this further this study considers the way in which the pedestrian experience is shaped at the level of the ground floor. The aim is to examine the role of *street configuration* and *building-street connections* in generating lively street domains in terms of probabilistic encounters.

Both Manhattan as a city, and the West Village as an area within it, present a unique history of urban transformations. Throughout its urbanisation Manhattan faced the challenge of incorporating higher densities within a constricted geographical area. Within Manhattan, the West Village is a special case that has managed to maintain its building stock and protect itself since 1969 with Historic District Designations. Row housing in the area has survived since the early nineteenth century by adapting to shifting spatial and social requirements. The combination of historical and non-historical buildings in the West Village creates a wide range of morphological street vistas. Residential properties are variously interspersed with institutional and commercial buildings while being in close proximity to the industrial west waterfront.

Similarly to Chapter 5, this chapter is also organised into two parts (6A and 6B). The first part introduces the West Village and examines the micromorphology of street interfaces in present. The second part applies historical research to look at diachronic processes of the street network and the built form in relation to the potentials for probabilistic street interfaces in terms of encounter density and diversity,

Chapter 6 Part A opens with Section 6.2 which presents a summary of the urbanisation processes seen in the West Village. This historical overview discusses the way the west waterfront came to develop an industrial profile in contrast to the residential heart of the West Village, which was designated as a Historic District in 1969. Section 6.3 provides a detailed understanding of the current *spatial* and *physical* structure of the area. Space syntax analytical methods reveal the properties of the street network in the local (neighbourhood) and global (city-wide) context, by relating the configurational properties of the grid with building form properties. Focusing on the physical structure of the ground floor level, the building properties considered here refer to building use and the density of entrances. Visual inspection of the maps shows that the West Village is an area where diversity is manifested across all scales: the building-scale, the street segment, the block-scale, the street-scale, and across different parts of the neighbourhood.

Overall, Chapter 6 provides an analytical insight into Jacobs's observations on the elements affecting urban diversity: mixture of uses, block length, building age, and density, with the latter considered here in terms of building-street interfaces. Discussion highlights the importance of piecemeal transformations and organisational consistencies across city components (buildings, plots, and blocks) in composing flexible urban complexes that generate greater mixing and more potential for probabilistic street activity over time.

6.2. History

Greenwich Village is one of the oldest parts of New York and today retains possibly the greatest assortment of dwellings dating from the days when the city was the Dutch colony of New Amsterdam. Originally a Native American settlement called 'Sappokanican', the area was cultivated by Dutch colonists for agricultural use (primarily for the harvesting of tobacco). The area was given the name 'Greenwich' by the British, who divided it into country estates. The Greenwich Village street grid dates from 1790, when the well-to-do citizens of the young Republic bought or inherited these country estates from colonists. At that time surveyors were hired to organise building development based on a pattern of planned streets and plots. In general, new streets followed the direction of existing main routes, such as Skinner Road (now Christopher Street), Greenwich Lane (now Greenwich Avenue) and Greenwich Street (see in Figure 75 the West Village in its early development). During this period of the early Republic development the area became the residence of prosperous tradesmen. Merchants and the bankers of Manhattan's financial district built summerhouses in Greenwich Village. These were soon to become primary residences as an escape from the commercial buzz of downtown (Historic District Designation Report, 1969, Vol. 1, p.11-12).

Figure 75. The West Village, Manhattan, c.1829.

Manhattan map by Hooker, W., c.1829; © David Rumsey Map Collection.
http://www.davidrumsey.com/

With the number of its inhabitants increasing, a public meat market was developed in the West Village in 1812. In general, Greenwich Village had formed a strong socio-spatial presence at the area west of Sixth Avenue (the West Village); in turn, this area was protected from the Commissioners' Plan of 1807-11. This 1807 act introduced the outline for the city Commissioner's street planning intentions, imposing a new grid at the edge of the already densely inhabited the West Village. The new plan was to commence at North (Houston) Street, Art Street (around Washington Square North) and Greenwich Lane, without invading the neighbourhood of the West Village (Ballon, 2012, p.29) (see Figure 74 shown earlier).

The 1820s and 1830s onwards saw New York flourish in domestic and foreign commerce in a way few could have foreseen. The prosperity of trade brought great population growth, and subsequently, the city's 'building boom' (Lockwood, 1972, p.3-7). This rapid urban expansion absorbed Greenwich Village, turning it into a 'boom town' (Ware, 1965, p.9). The congestion in Lower Manhattan caused a series of epidemics of cholera and yellow fever, and these, combined with a desire to escape the buzz of downtown businesses, pushed merchants and wealthy citizens northwards in the city. The years between 1825 and 1840 saw a four-fold increase in Greenwich Village's population – enough to allow for the heart of the Village to develop as a primary residential neighbourhood with institutional and commercial services (including New York University, which opened in 1833).

While the areas surrounding Washington Square were filling up with single-family row houses, the western side of Greenwich Village, with its piers and transfer depots, was developing a different character: here, the industrial, manufacturing and commercial businesses associated with the harbour mixed with middle-class housing (Landmarks Preservation Commission Report, 159 Charles Street House, p.3). This functional distinction was also evident in the built form. Dolkart discusses how the economic diversity and social hierarchy of the area's inhabitants were *'reflected in the architecture of different sections of the neighbourhood'* (Dolkart, 2009, p.115-116): starting from Washington Square and moving towards the west waterfront, row houses were gradually shifting from a grandiose and imposing style to a more modest character, with multiple occupancy becoming the norm. Analysis in the following sections of the chapter shows that this socio-spatial distinction between the constituent parts of the neighbourhood persists throughout time.

The end of nineteenth century found the West Village surrounded by the pressures of change (Figure 76). To the west, the development of the Hudson River piers boosted the rapid growth of industrial uses and heightened the need for working-class housing. To the south-east, tenement developers were taking over the city blocks, replacing the old row houses in response to a demand for higher density housing. The north-eastern part of the neighbourhood (between Washington Square and 14th Street) was threatened by a commercial invasion arising from the impact of the popularity of Broadway. These forces changed the social profile of the area, mixing immigrants with what had so far been an almost exclusively locally-born population. The once desirable prosperous neighbourhood saw its appeal wane, giving way to decline and causing a housing crisis in the West Village (Landmarks Preservation Commission Report, 159 Charles Street House; Dolkart, 2009, p.116-117; Ware, 1965, p.11-14).

Figure 76. The West Village, Manhattan – urban challenges at the turn of twentieth century.

By the 1920s these changes in the surrounding urban context had turned Greenwich Village into one of the best-connected areas in the Manhattan grid, and this threatened even more the preservation of the old neighbourhood's socio-spatial context (Figure 77). The pressures of development at a scale to match what was taking place elsewhere in the city forced the extension of street lines that cut through the area's blocks, disrupting the physical unity of the neighbourhood (see Figure 78). These grid transformations include the extension of Seventh Avenue southwards in 1914 and the completion of a second subway system in 1918 which coincided with the southern extension of Sixth Avenue.

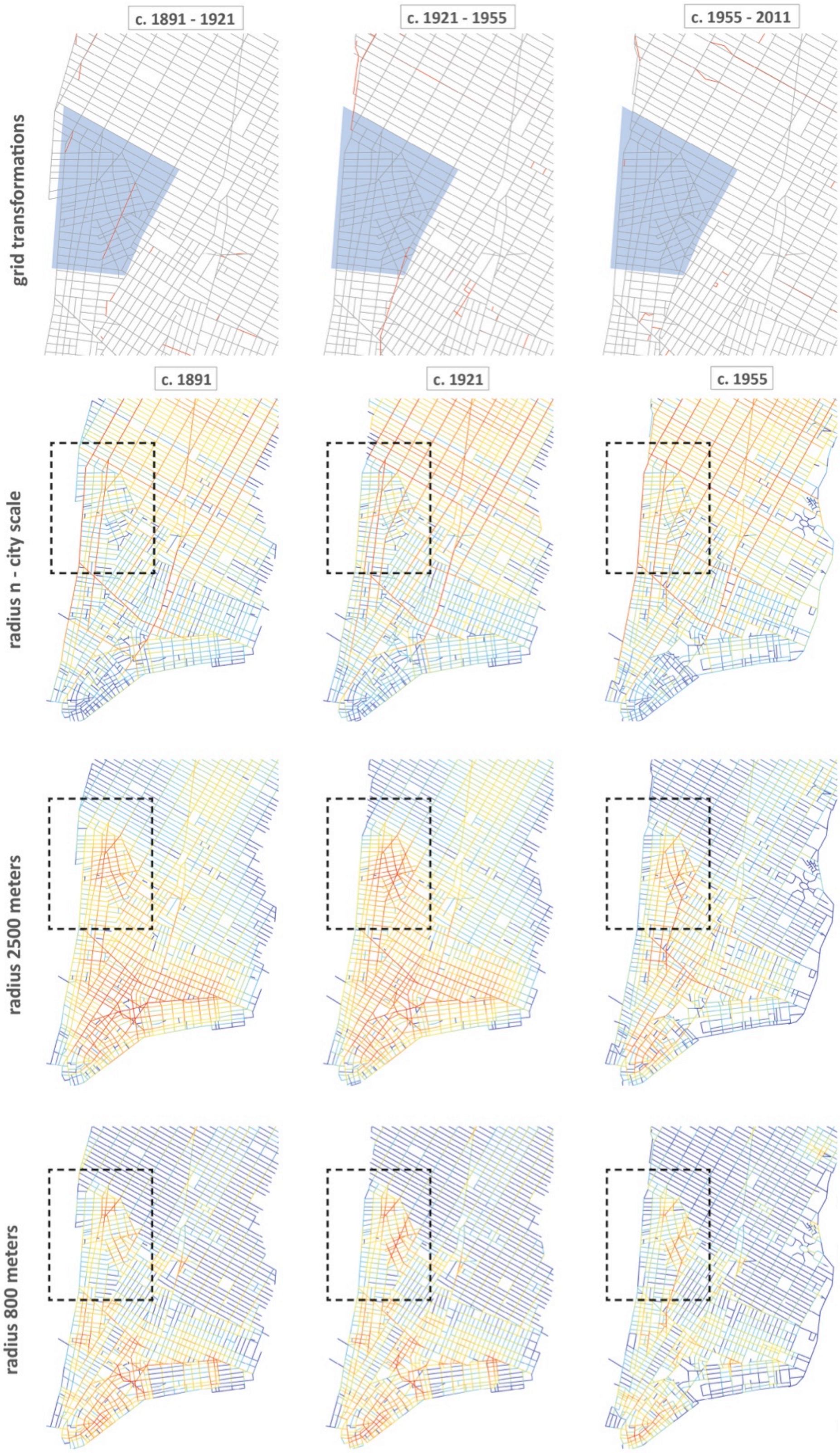


Figure 77. Manhattan: grid transformations for c.1891-1921, 1921-1955, 1955-2011.

Segment maps show the *combined measure of integration and choice* for different radii. Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

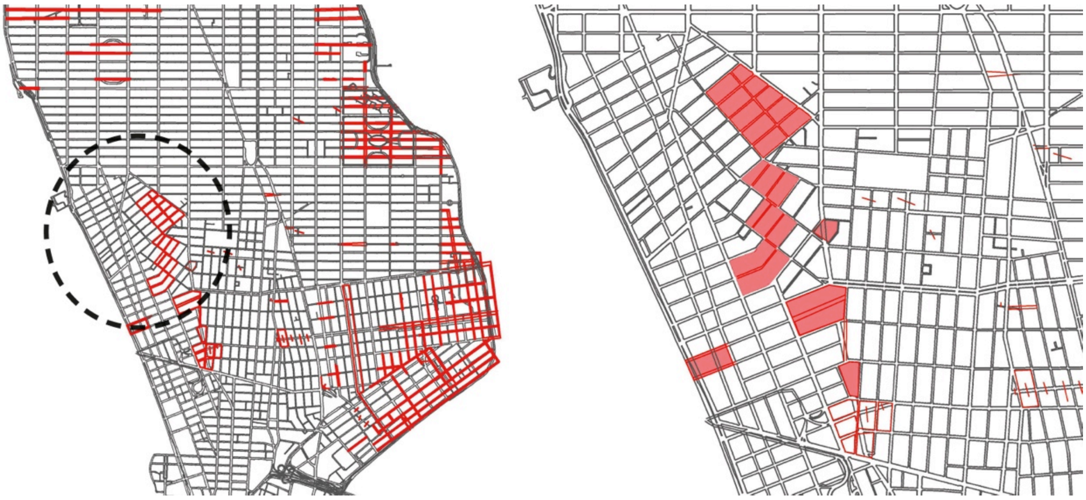


Figure 78. Manhattan – grid transformations, c.1891-1921.

Changes are marked in red. The map on the left shows blocks affected in the West Village.

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

However, in the face of all these changing forces generated by the city's 'great boom', a number of factors enabled the preservation of a substantial proportion of historical buildings and the surviving residential character of the area. *Firstly*, a spatial parameter: the street layout of the area, with its angular deviation from the rest of Manhattan grid, acted as a barrier to through traffic, as did the city-wide connectivity of its north-south avenues from the commercial pressures arriving from Broadway. *Secondly*, a number of socio-economic factors: residences in the area were family-owned for generations, fostering the concern of inhabitants for the future of the West Village. This concern led in 1906 to the establishment of the Washington Square Association, an organisation aiming to protect the 'desirable' residential character of the area. As Dolkart describes (*ibid.*, p.116-118), inhabitants found a common cause with local merchants (the Central Mercantile Association) and real estate developers with interests in the area, as well as the People's Institute (est.1897) that protected the rights of workers to decent social living. These commercial and social parties influenced political actions that worked in favour of safeguarding the residential heart of Greenwich Village, such as the 1916 Zoning Commission regulations (Ware, 1965, p.14) which provisioned residential, commercial and manufacturing (light industrial) zoning districts to co-exist in the area.

The first decades of twentieth century saw a reverse in the area's decline. A decrease in rental values during the previous years allowed artists, journalists and young professionals of little means to move into the West Village. Dolkart's study discusses in detail how the 'architecture of bohemia' regenerated the picturesque character of the area with piecemeal alterations of individual row houses. This rehabilitated row house streetscape, along with the area's proximity to the city centre, refuelled the West Village's appeal. The building of tenements abated, and previously multi-occupancy, poor standard row houses were split into high-rent apartments.

The complex and varied factors that shaped the socio-spatial context of Greenwich Village have cultivated a heterogeneous neighbourhood where supposedly 'conflicting' urban uses are found in close proximity. The high presence of many surviving row houses and historical buildings, in combination with the West Village's socio-economic mixture and vibrancy, confirmed the uniqueness of the neighbourhood when in the 1960s Jacobs argued in favour of its historical preservation. The Historic District Designation of the heart of Greenwich Village was applied in 1969 (notably, the same year as the designation of conservation areas in Islington), when the Landmarks Preservation Commission declared blocks with a strong historical row housing presence as protected. Figure 79 shows the extent of Greenwich Village included in the 1969 Historic District. The case study here focuses on the western part of Greenwich Village, the West Village, covering the majority of the historical blocks at the west side of Sixth Avenue. Figure 76 highlights three additional Historic District Extensions within the case study area, designated in 2003, 2006 and 2010.

The following section examines the case of the West Village through the use of space syntax and urban form analytical techniques. Starting with a detailed reading of the current streetscape and continuing with an investigation of the physical history of the area, two main inquiries will be addressed:

- What is the impact of the street layout in built form transformations over time?; and
- are there any traceable spatial and physical aspects which enhance potentials for a micromorphology that supports probabilistic encounters?

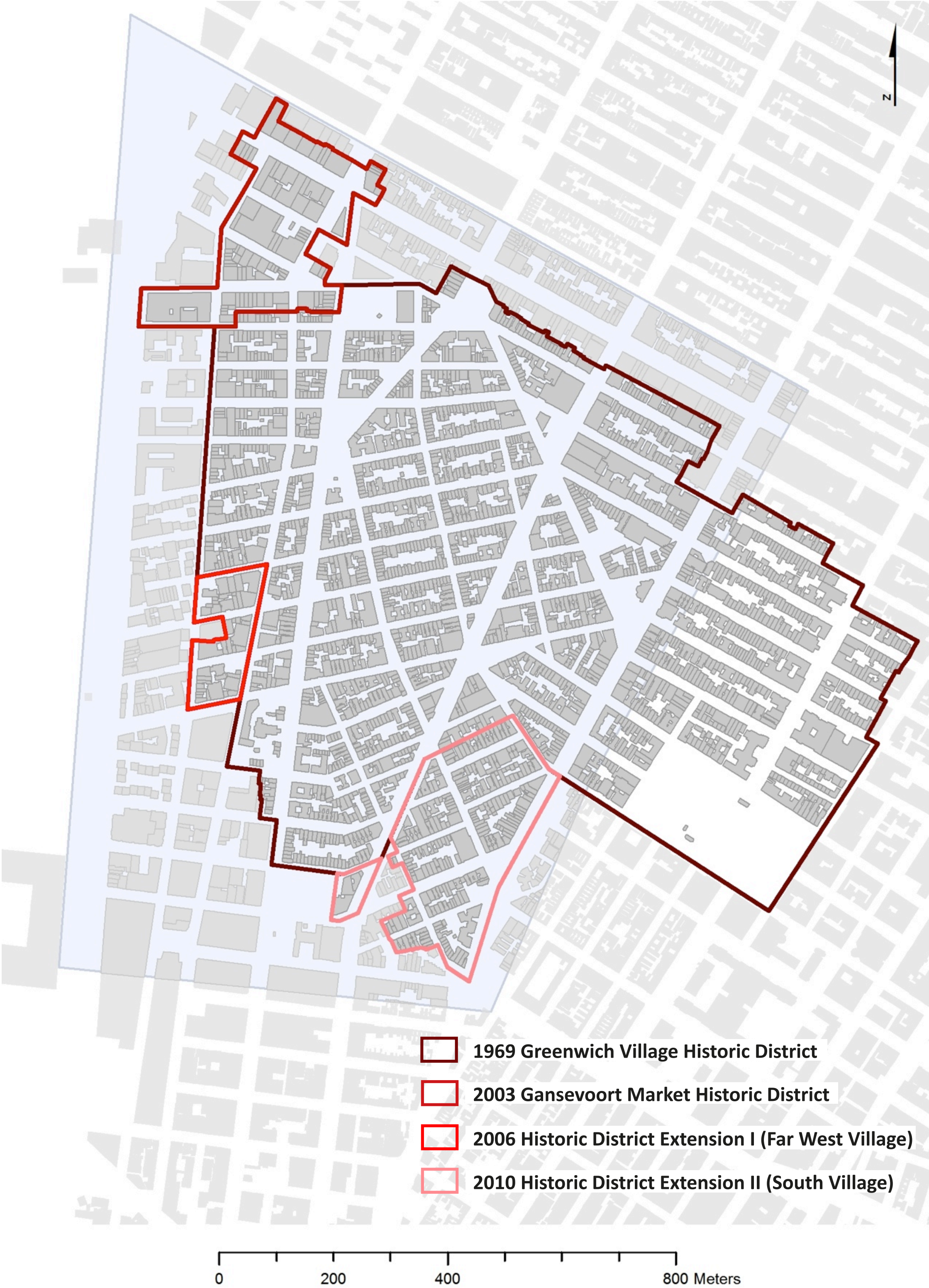


Figure 79. The West Village, Manhattan: Historic Districts.

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

6.3. A reading of the streetscape

As in the study of Islington, this first analytical section surveys the current urban situation in the West Village with the aim of understanding the area's *spatial* (street network) and *physical* structure (built form). The study focuses on the streetscape at the ground level, looking at the current land use allocation and at building-street interfaces. Analysis of land uses is intended to reflect the social context of events taking place in the West Village streets. Furthermore, analysis of building-street interfaces is meant to reflect the potential for social encounters generated by building entrances. This study examines in particular the differences between Historic Districts of the West Village and areas that have changed significantly over time. The analysis considers (a) the structure of the area in terms of street configuration, and (b) the way in which the historical split between the farthest reaches of the West Village to the west, and its protected heart, compose street interfaces of different micromorphology for users. The discussion reveals insights relating to Jacobs' observations of short blocks as a factor for diversity, and to the area's mixture of uses and street interface.

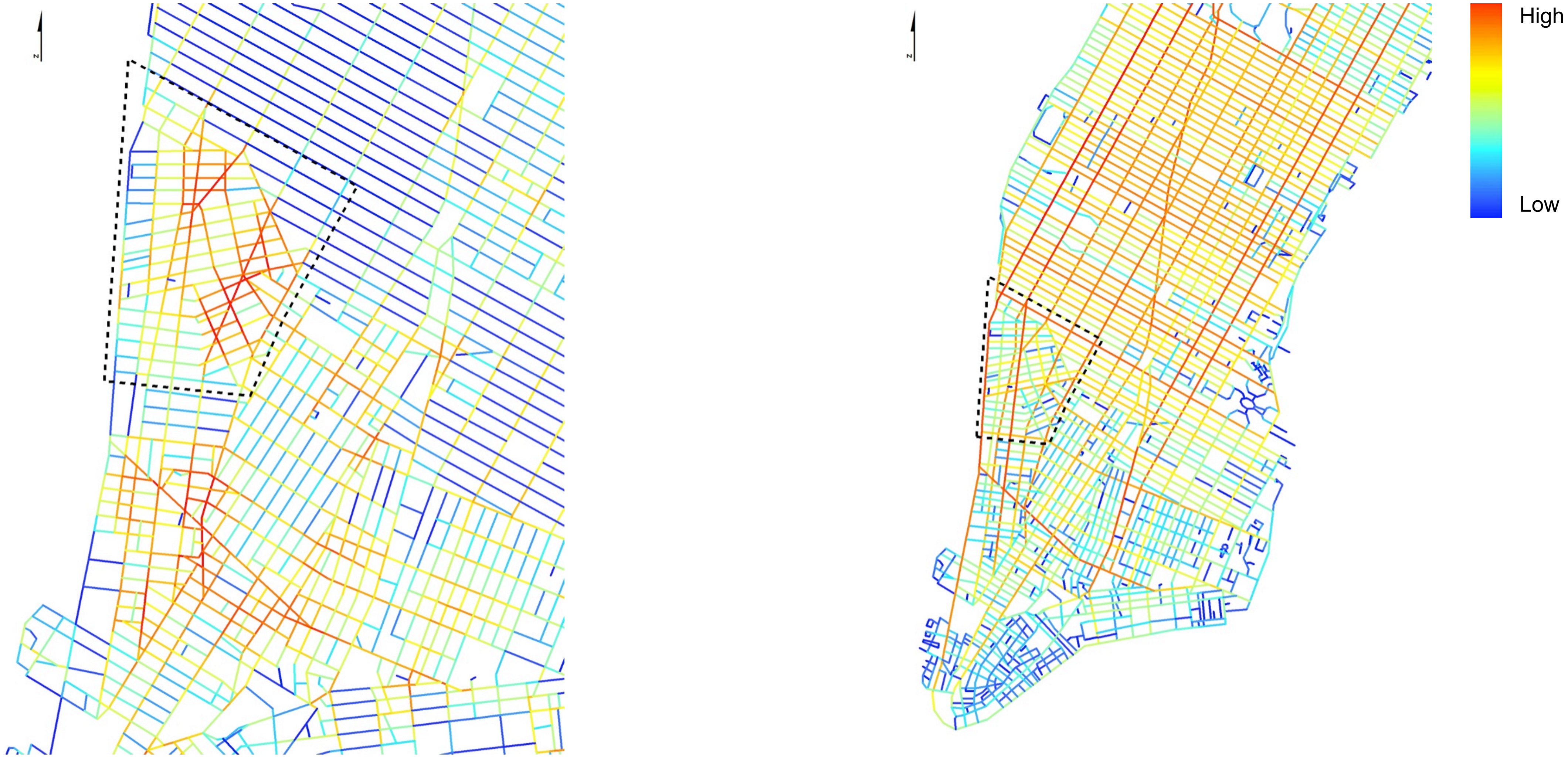
6.3.1. Street layout

The area called the West Village starts at the west side of Sixth Avenue extending to the west waterfront, and is bounded by West Houston in the south, and 14th Street in the north. The study area covers all 130 blocks of the West Village. The area's street network comprises 333 street segments with a total segment length of 28.6km. Syntactical analysis of the area was performed within the wider context of the Manhattan grid (reaching 7,785 segments in total, with total 833.1km segment length). Table 22 summarises the basic street network properties of the case study. In general, the West Village presents shorter street segments on average (86m) – and consequently smaller blocks – than those seen in the typical Manhattan pattern (107m). The Commissioners' blocks extending upwards from West 14th Street can be fully twice the size of blocks found within the West Village. While the study area includes in its northern part a number of blocks that comply with the dimensions of the Commissioners' plan, here the majority of built form islands have shorter sides, resembling the more playful downtown grid. More specifically, half of the West Village (55.3%) is comprised of segments between 50-100m long. Another fifteen per cent (15.1%) are very short segments with length less than 50m. The presence of very small blocks is explained by street extensions that divided the already small blocks in the area and created many junction points in the street layout. 23.8% of street segments fall within the range of 100-150m and just 5.8% of segments can be described as very long (150m and over). To allow comparisons, the long side of a Commissioners' typical block can reach up to 183m (600ft; see Plunz, 1990, p.48).

TABLE 22 c.2011	**0 < 50 m**	**50 – 100 m**	**100 – 150 m**	**150 – 200 m**	**200 m and over**
Segment Count	47 15.1%	172 55.3%	74 23.8%	10 3.2%	8 2.6%
Total length	1.723 km 6.2%	12.922 km 46.5%	9.480 km 34.1%	1.618 km 5.8%	2.058 km 7.4%

Table 22. The West Village, Manhattan – street segment length distribution. (c.2011)

At the turn of twentieth century, the centrality of the neighbourhood was significantly increased by the extension of highly integrated streets (Seventh Avenue in 1914 and Sixth in 1918), and by the construction of a second subway system (in 1918). In the 1930s the West Village became a 'passing through' area for the city-wide pedestrian traffic. In the study area, the main through-arteries that consist significant city-wide connections are: Hudson Street, connecting the West Village with north-west Manhattan via Ninth Avenue; Seventh and Sixth Avenues which are the north-south mid-Manhattan connections; and West 14th Street which connects the West Village to the eastern Manhattan districts. However, by scrutinising the syntactical values of the *combined measure of integration and choice* – in other words, the potential for both *to* and *through* movement – it can be seen that the area works differently in terms of permeability at different city scales (Figure 80). In the city-wide network (analysis performed for radius n) the most significant arteries are the older streets, Hudson Street and West 14th. Hudson connects the area with the downtown city centre and West 14th is the historical frontier where the Commissioners' Plan meets old Manhattan. On the other hand, when considering a walkable scale (800 meters), Seventh Avenue attracts the highest movement potentials in the heart of the West Village. In addition to pedestrian flows, it is notable that the majority of subway connections also occur on Seventh Avenue.



radius 800 meters **radius 2500 meters**

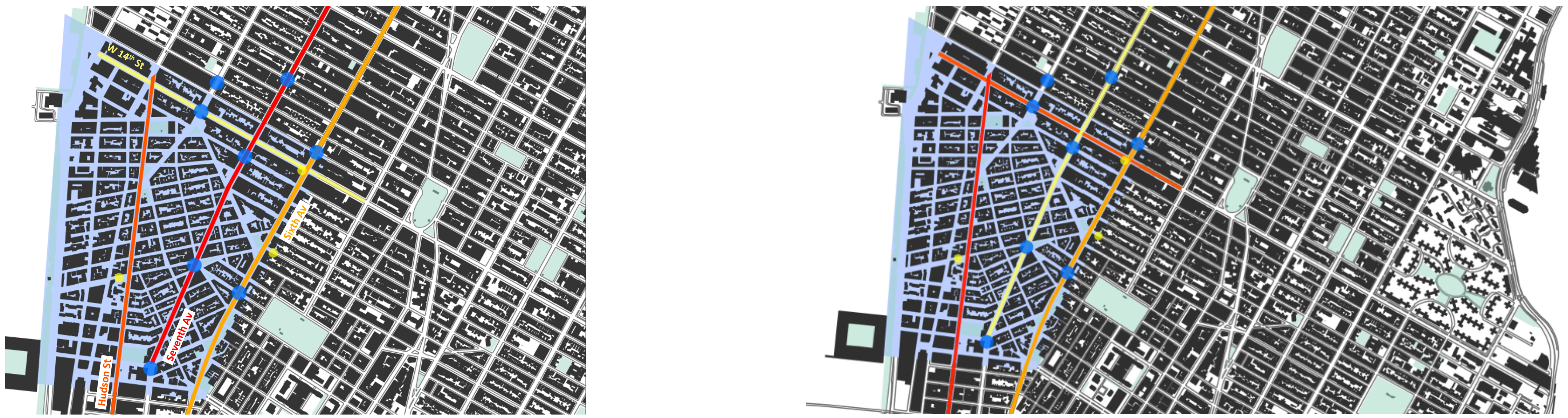


Figure 80. The West Village, Manhattan – street network; global and local properties. Showing segment angular analysis for the measure of *combined integration and choice*, radii 800 and 2500 meters,

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

6.3.2. Land uses

This increased centrality within the city created a greater pressure for non-domestic uses in the area. By 1961, the land zoning in the West Village had changed to include commercial and mixed uses alongside the more residential parts. Space syntax studies have shown that the functional distribution of uses throughout the urban grid is dependent on the syntactical properties (namely, the configurational/relational properties) of its street layout and on the ‘multiplier effect’ of an increased centrality generated over time by a growth in commercial activity in streets high in pedestrian traffic (Hillier and Vaughan, 2007). It is thus expected that the majority of commercial uses will be allocated along the main streets mentioned previously. To test this proposition, Figure 81 presents a detailed map of building thresholds coloured according to land uses in c.2011, captured in a spatial database for the study area.

The building use record confirms the role of Seventh and Sixth Avenues as the area’s primary commercial routes (Table 23). Around two thirds of thresholds facing these streets are classified as retail (74.0% for Seventh Avenue and 70.1% for Sixth). Bleecker Street follows, with commercial entrances at 61.9%. When looking at syntactical values of the main streets (Table 24), it is interesting to observe that Bleecker Street is not important at the city scale, whereas in the local context of the West Village and the surrounding neighbourhoods (radii 800m to 2500m) Bleecker presents one of the highest potentials for *to* and *through* movement. The street is protected from high vehicular traffic due to its narrow street width in comparison to the wider Hudson Street, Seventh and Sixth Avenues. The fact that Bleecker Street is protected from city-wide pedestrian flows while attracting at the same time local life, has created one of the West Village’s liveliest streets for social encounters (Figure 82) – resembling in a way the street function of the UK high street (Jones et al., 2007). West 14th on the other hand presents quite the opposite syntactical properties: the street has a stronger significance within the wider Manhattan context (radius n). West 14th presents as well a different land use profile, outranking by far the other main streets in offices and light industry (‘other’ uses). Finally, looking at the allocation of domestic thresholds in Figure 81, these appear to cluster more in the narrower streets within the interstices of the West Village grid[46].

[46] A similar extended analysis to that applied in Islington for the West Village street segments with high, middle and low syntactical values in *combined integration and choice* and their relation to land uses is discussed in Palaiologou and Vaughan (2014a).

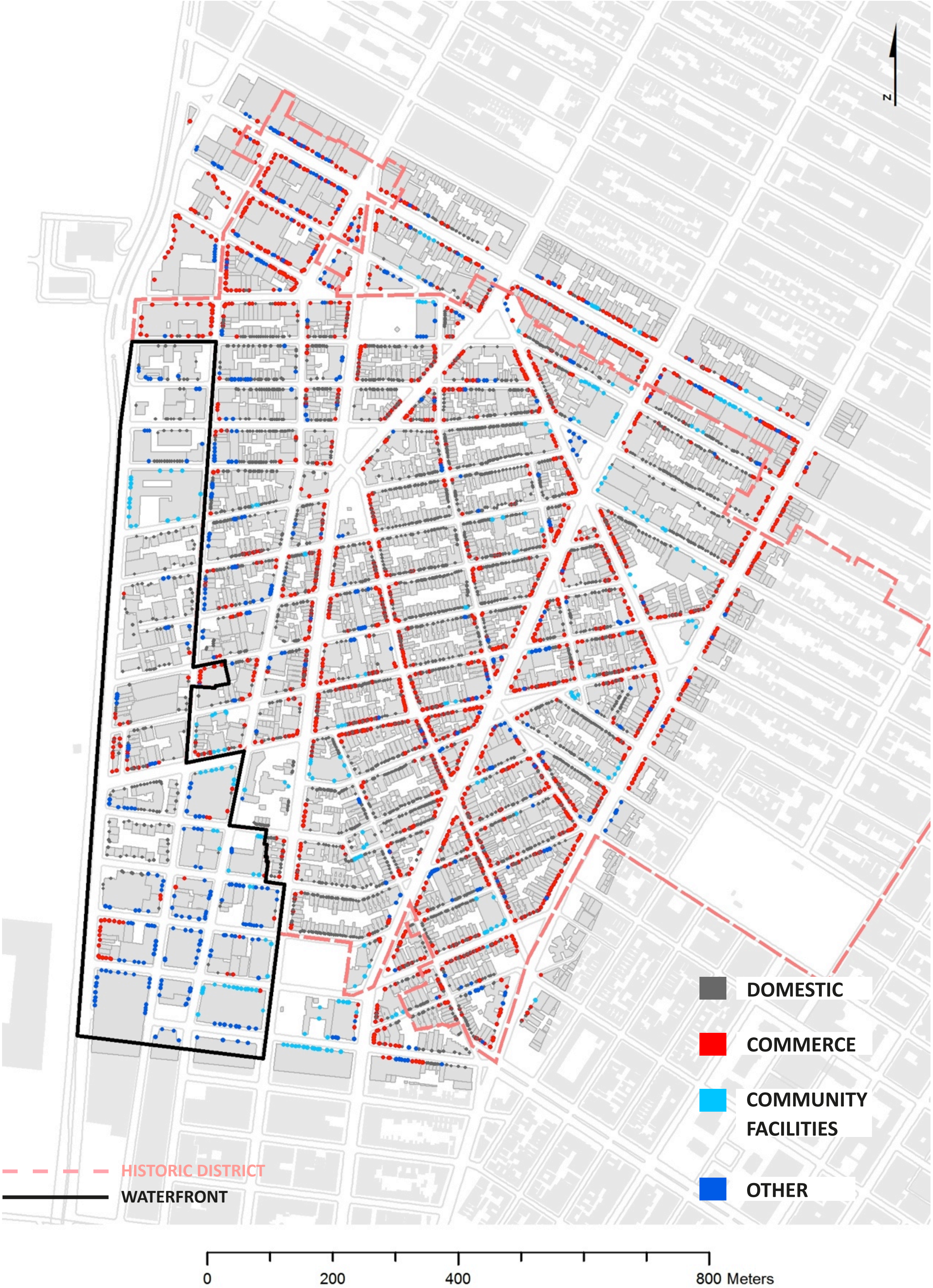


Figure 81. The West Village, Manhattan – building thresholds and land use. (c.2011)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

TABLE 23 Main Streets; Use	Façade	Doors	Domestic	Commercial	Community	Other
Hudson St	124	251	91 36.2%	139 55.4%	9 3.6%	12 4.8%
Seventh Av	79	162	21 13.0%	120 74.0%	10 6.2%	11 6.8%
Sixth Av	101	224	44 19.6%	157 70.1%	6 2.7%	17 7.6%
West 14th	134	303	65 21.4%	152 50.2%	26 8.6%	60 19.8%
Bleecker St	123	244	84 34.4%	151 61.9%	3 1.2%	6 2.5%

Table 23. The West Village, Manhattan – main streets; building threshold use. (c.2011)

TABLE 24 Main Streets; Syntax	INT_CH R800	INT_CH R1000	INT_CH R1600	INT_CH R2000	INT_CH R2500	INT_CH Rn
Hudson St	50.43	87.09	247.83	382.22	575.80	22021.11
Seventh Av	68.58	112.02	295.23	458.96	695.85	19269.28
Sixth Av	35.42	63.06	183.43	308.98	507.65	17821.38
West 14th	14.38	24.90	98.88	172.41	295.14	21038.98
Bleecker St	67.77	112.57	306.72	476.00	696.86	12924.51

Table 24. The West Village, Manhattan – main streets; street network properties for the measure of *combined integration and choice*. (c.2011)

Figure 82. Bleecker Street, the West Village, Manhattan.

The effect of the 1961 zoning regulations is also apparent (Figure 83). This zoning act emphasised the historical split of the area. The west waterfront is designated as 'M1-5' district. M1 districts, as described by the New York City Department of City Planning, are those in which light industrial uses[47] are permitted, as well as offices, hotels, retail uses, hospitals (with restrictions) and houses of worship. The conversion of industrial sites into residential spaces is also allowed. M1-5, in particular, permits artistic studios and work-live spaces. Zoning allowances in the remaining Village sections range from residential (R6), to commercial-residential districts (C1-6; C2-6), to predominately commercial centres (C4-5; C8-4). This historical functional split of the area, arising as a consequence of network and zoning effects, becomes apparent on analysis of the current distribution of uses (Table 25). In general, for the West Village parts lying outside the Historic District, non-domestic uses (64%) are almost twice the number of domestic uses (33.2%).

[47] Light industrial uses mentioned are woodworking shops, repair shops, and wholesale service and storage facilities, [e source: <http://www.nyc.gov/html/dcp/html/zone/zh_m1.shtml>]

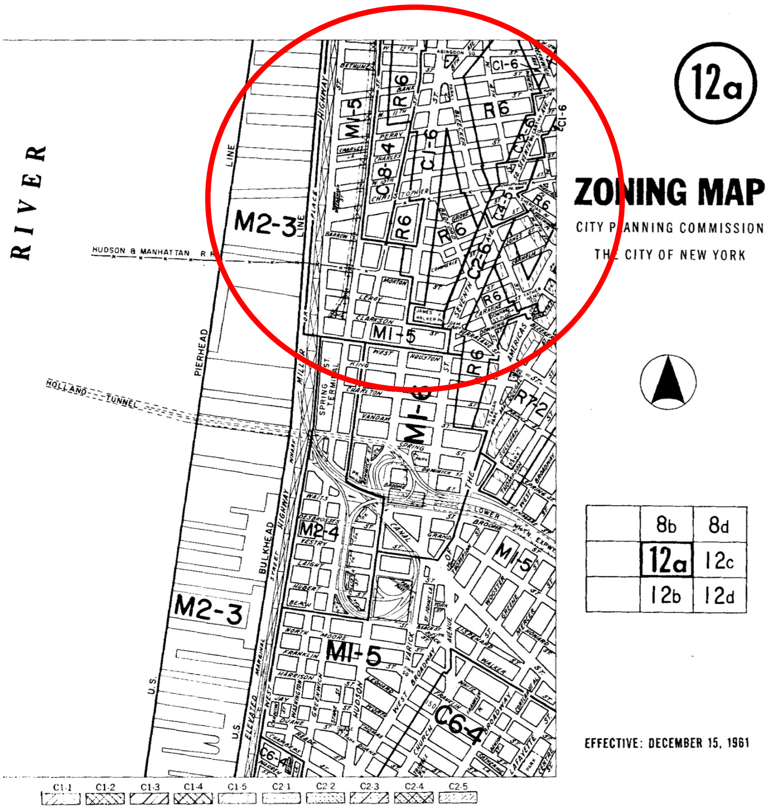


Figure 83. The West Village, Manhattan – Zoning Map, City Planning Commission, December 1961.

Background map: © City of New York.

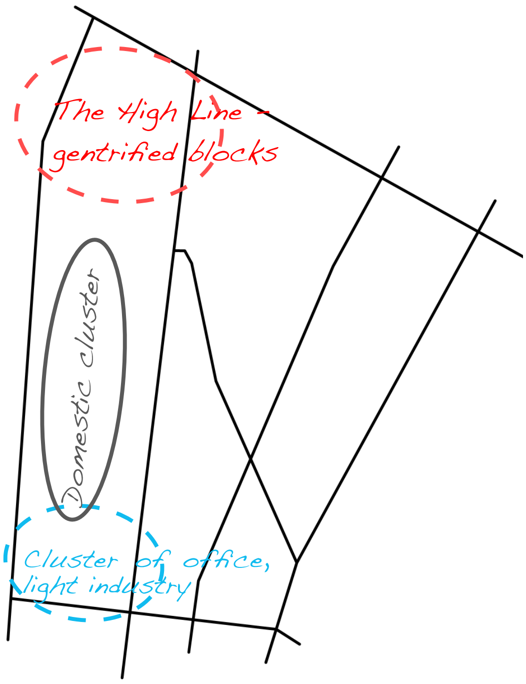


Figure 84. The West Village, Manhattan – waterfront land use clusters.

More particularly, when looking at the west waterfront (and especially at the south-western part of the map in Figure 81 and sketch in Figure 84) offices and light industry predominate all other uses: for the waterfront area, building thresholds for these uses take up 60.9% of non-domestic thresholds. Residential redevelopments can also be seen moving northwards along the waterfront, as well as the gentrified northwest part of the High Line (Gansevoort Market Historic District), where there is almost exclusively a mixture of commerce and offices. Notably, in the waterfront area similar functions appear to cluster alongside neighbouring blocks, while in the Historic District a greater amount of mixing is observed along each segment length. Finally, the Historic District remains predominately residential (57.2%), while most of the non-domestic building thresholds are commercial (32.5% of total thresholds; 76.4% of non-domestic). Zooming in to the threshold map (see Appendix for higher resolution, Figure A6.2), the commercial-residential units of row houses can be distinguished, demonstrating the way in which residential streets have been infused with retail activity over time.

TABLE 25 Districts	Façades	Doors	Domestic uses	Commer uses	Commun services	Other uses	Vacant	Stoop	Direct entrance
Historic District	2354	4449	2547 57.2%	1430 32.1%	134 3.0%	308 6.9%	30 0.8%	908 20.4%	3447 77.8%
Non-historical	494	1064	353 33.2%	319 30.0%	109 10.2%	253 23.8%	30 2.8%	98 9.2%	927 87.1%
Waterfr.	249	518	205 39.6%	63 12.2%	54 10.4%	182 35.1%	14 2.7%	58 11.2%	442 85.3%

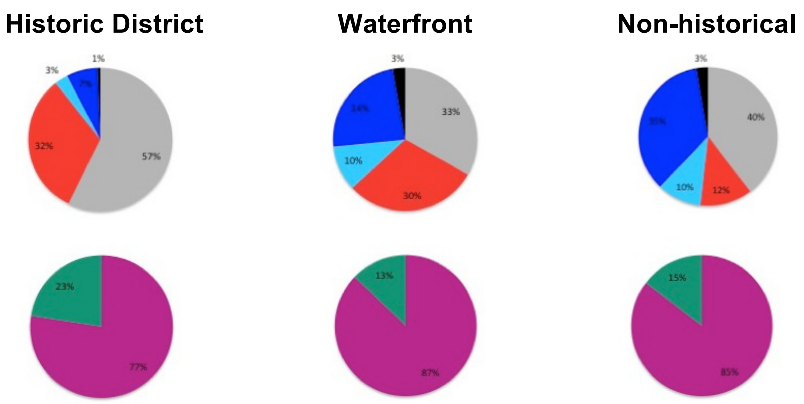


Table 25. The West Village, Manhattan – Historic District v. west waterfront; building threshold use. (c.2011)

Overall, the record of building uses indicates a neighbourhood with functional mixture at various scales: across neighbourhood parts (historical, non-historical, waterfront); within parts, with a clustering of uses; across street segments, with varying uses mixing together at the block scale; and even, finally, at the building scale. It then becomes of interest to explore whether there are specific properties of the street configuration which entail this functional diversity. A key characteristic of the street layout in the West Village, as mentioned previously, is that the area contains small blocks. Short block sides enhance ‘fluid street use’, or permeability (Jacobs, 1961, p.183). According to space syntax studies, *accessibility* and *permeability* attract more urban-like uses such as retail. Indeed, the record of thresholds (Table 26) and syntactical analysis (Figure 85) signify the potential effect of street segment length (and respectively of block size) on building functions.

TABLE 26 Segment length	**0 < 50 m**	**50 – 100 m**	**100 – 150 m**	**150 – 200 m**	**200 m and over**
Segment Count	47 15.1%	172 55.3%	74 23.8%	10 3.2%	8 2.6%
Total length	1.723 km 6.2%	12.922 km 46.5%	9.480 km 34.1%	1.618 km 5.8%	2.058 km 7.4%
Total façades	124	1220	1065	184	254
Total doors	219	2322	2070	397	501
Domestic	86 39.3%	1012 43.6%	1317 63.6%	219 55.2%	266 53.1%
Non Domestic	133 60.7%	1306 56.2%	731 35.3%	178 44.8%	234 46.7%
Commercial	105 47.9%	994 42.8%	418 20.2%	119 30.0%	146 29.1%
Community	4 1.8%	75 3.2%	93 4.5%	22 5.5%	48 9.6%
Other	24 11.0%	237 10.2%	220 10.6%	37 9.3%	40 8.0%
Blank	12 5.2%	209 9.0%	222 10.7%	70 17.6%	45 9.0%
Indirect thresholds	30 13.7%	346 14.9%	511 24.7%	93 23.4%	155 30.9%

Table 26. The West Village, Manhattan – segment length and building thresholds. (c.2011)

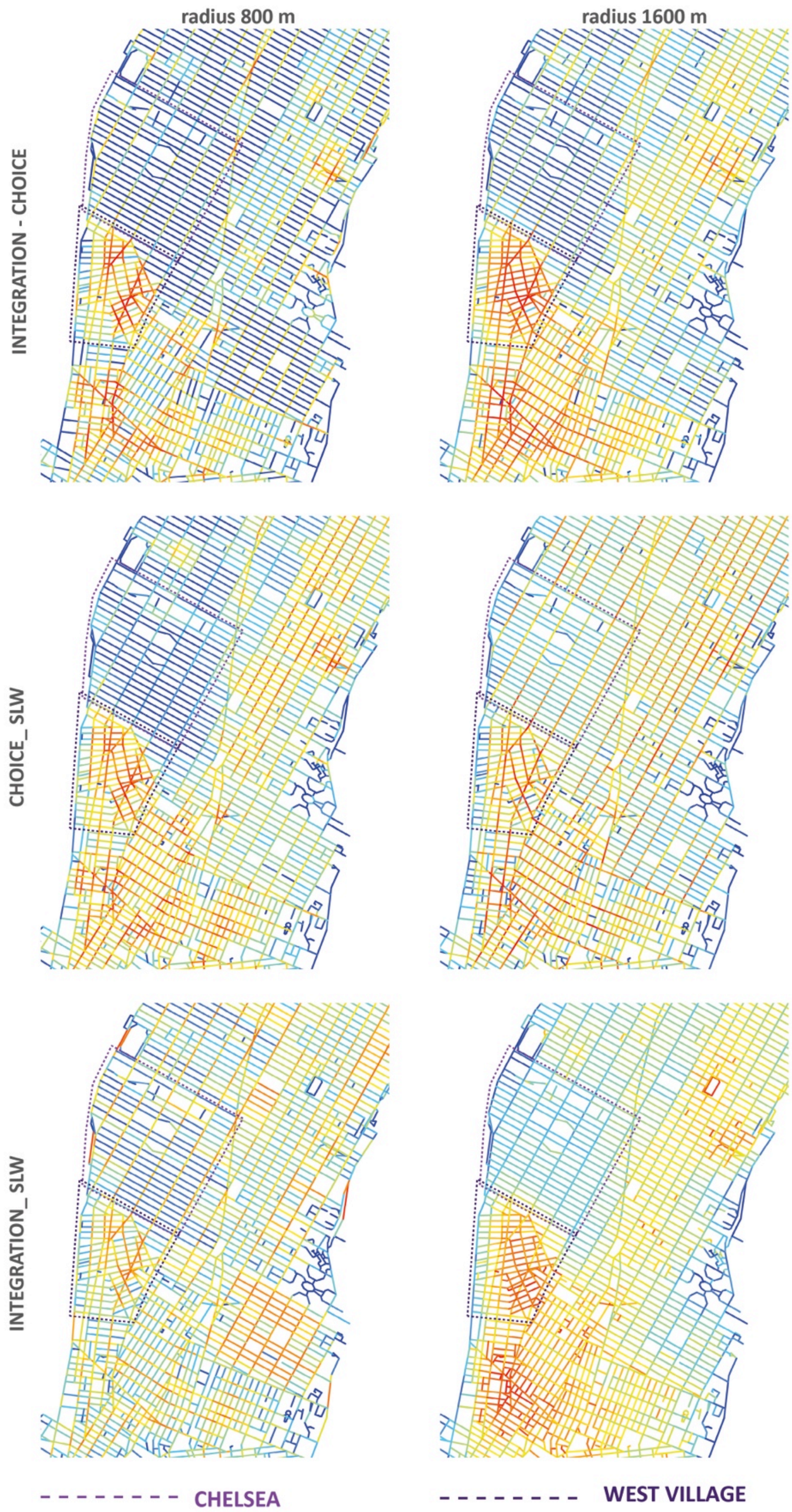


Figure 85. The West Village and Chelsea, Manhattan – short and long street segments. (c.2011)

Showing segment angular analysis for the *combined integration and choice* (top), the *segment length weighted choice* (middle) and the *segment length weighted in*tegration (below). Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

Table 26 summarises threshold uses for segments classified based on segment length. A basic difference is observed: for segments with a length below 100m, non-domestic uses outrank the domestic; the opposite is true for segments over 100m, where residences are more frequent. In addition, the majority of commercial thresholds are also gathered in shorter segments. The fact that shorter segments present almost half the number of secondary boundaries observed in longer segments is another factor implying a more urban profile for short block sides.

To examine this further we can compare the street configuration in the West Village with that of the Commissioners' longer blocks at the north side of the West 14th boundary (the area called Chelsea) (Figure 85).[48] Street network analysis with the *combined integration and choice* syntactical measure at a neighbourhood scale (radii 800m and 1600m) reveals the potentials for accessibility and permeability for the West Village and Chelsea. It is evident that the highest movement potentials (red colour range) are gathered along the short segments of the West Village, as well as along short segments in Chelsea, and in Manhattan in general. In order to minimise the effect of segment length in calculating syntactical properties of the street network, *segment length weighted measures* for both *choice* (measuring potential *through* movement) and *integration* (potential *to* movement) were tested as well. Here, again, results show the highest values for short segments. In other words, a syntactical analysis of the street network also indicates a correspondence between segment length and functional diversity.

6.3.3. Building-street interface

Building-street connections are influenced by a diversity in both the use, and morphology, of the buildings in question. Morphological diversity is considered here in terms of (a) the entrance density of buildings and across block fronts, and (b) the type of building-street transition (direct or via secondary thresholds).

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[48] Jacobs compares Greenwich Village with its neighbouring areas, Chelsea and the east side of Greenwich Village (1961, p.183-184) in order to substantiate her arguments regarding block size and land use mixture. Her comparative observations contend that the lack of diversity in Chelsea is a spatial effect of longer block sides. Here, space syntax analysis allows for a more rigorous attempt to examine the author's observations.

Accordingly, besides the functional differentiation between historical and non-historical parts discussed earlier, a shift in the density of building thresholds in each case is noted and analysed through a direct observation of buildings within the entire study area. The results show those blocks which form part of the Historic District have a significantly higher frequency of entrances, resulting from the smaller building scale of row houses. Within the Historic District plots are regularly arranged with a consistently narrow façade width[49], while near the waterfront single building footprints may take up a whole block. Table 27 summarises the distribution of building entrances recorded in the historical and non-historical parts of the West Village (c.2011). Results show that the mean façade length for buildings within the Historic District is almost half the length of façades outside the District. To understand this in terms of density of building entrances, when walking within the Historical area pedestrians are likely to find an entrance every 6 meters on average. In the non-historical parts, the scenery changes to a more dispersed street interface, with an entrance anticipated every 10 meters. In the waterfront area in particular, doorway spacing increases further, with a door potentially found every 13 meters on average.

TABLE 27 Districts; Street interface	**Façades**	**Doors**	**Total Façade Length (m)**	**Mean Façade Length (m)**	**Door encounter rate (m)**
Historic District	2354	4449	26742	11.4	6.0
Non-historical	494	1064	10871	22.0	10.2
Waterfront	249	518	6554	26.3	12.6

Table 27. The West Village, Manhattan – Historic District v. west waterfront; street interface. (c.2011)

[49] In a typical Manhattan block, the regular plot width is 25-feet wide (Plunz, 1990, p.48). In the West Village, an older part of New York, plots range from 18 to 25-feet wide; plots of 21 feet appear to be the most frequent (as recorded in Bromley & Co. Fire Insurance Maps, c.1921).

Interface density

The number of building-street connections aggregated within a block front plays a significant role in the composition of the street interface. Thresholds imply interior-exterior connections; or, in other words, potential private-public encounters. While Table 27 provides a general picture of this element of the street interface, its calculations assume an evenly constituted urban streetscape: that is, it assumes an equal number of door entrances across all block-fronts for each distinct part of the West Village. However, this smoothes over the reality of a diverse street environment that needs to be analysed at the street segment scale to truly understand the significance of its widely differing characteristics, namely, the number of buildings, the length of building façades and the number of entrances. Consequently, in order to form a more detailed overview of the area's streetscape, segment sides (or block sides) are studied separately and classified in terms of *interface density*. To recall, interface density refers to the extent (length) and frequency of the potential encounters presented by the built form alongside a street segment, considering three main measures:

(1) the block front length in relation to segment length (*bf/sl* ratio) – in other words the extent to which a segment side is built up;

(2) the current threshold frequency (*tf*); and

(3) the current threshold frequency in comparison to the historical threshold frequency (*hft/tf* ratio).

The following maps show building sides coloured based on these measures. Considering the *bf/sl* ratio (Figure 86) for the Historic District and the west waterfront it can be seen that the West Village street sides are significantly built up throughout; notably, in the waterfront area there seems to be very little space left uncovered.

Figure 86. The West Village, Manhattan – *block frontage length* per *street segment length* for street segment sides. (c.2011)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

Figure 87. The West Village, Manhattan – *threshold frequency* for street segment sides. (c.2011)

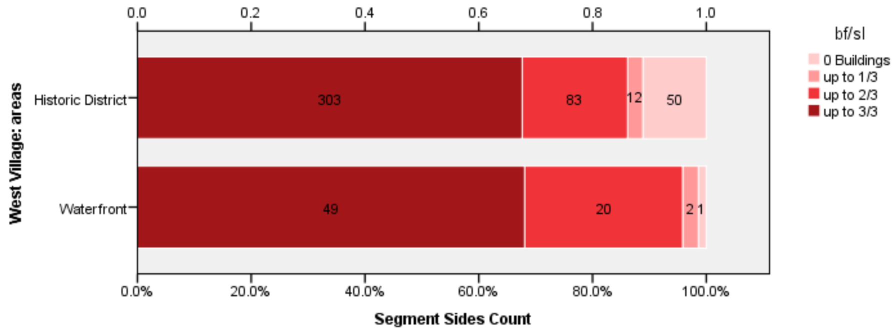
Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

Looking closely at the map in Figure 86 it can also be seen that building footprints in the west waterfront shift in size and become larger than those of the Historic District; frequently they even cover the entire block island. With this in mind and considering that the *threshold frequency* in the West Village appears to fade in colour within the waterfront section (namely, thresholds become more sparse; Figure 87) it is reasoned that in moving towards the waterfront pedestrians are surrounded by buildings with increasingly long façades and sparse building street connections.

This observation is also supported by the *historical threshold frequency / current threshold frequency* ratio (Figure 88). In order to measure this ratio the study assumes a minimum of one entrance per building. It calculates one entrance per 6.4 meters to represent the typical width of a row house frontage within the area prior to its adaptation, either for commercial or multiple occupancy (6.4 meters is equal to 21 feet). Since the early nineteenth century the typical row house plan (Federal row houses), was established at between twenty to twenty-five feet wide and thirty-five to forty feet deep (Lockwood, 1972, p.14). The West Village row houses range within these front dimensions. 21 feet is the most frequent historical row house façade width found in the area. Figure 89 summarises the properties of street segment sides for these two contrasting areas. Also, Figure 90 shows the configurational properties of the street network in each case calculated with the measure for *combined integration and choice* (c.2011). While within the Historic District varying frequencies of doorways equally appear (high, historical, low), it is clear that a significant majority of entrances within the waterfront follow a sparse pattern. Interestingly, space syntax values follow a comparative pattern: segments from all groups (high, middle, low) are found in the Historic District, but the waterfront segments come exclusively from the group with lowest syntactical prominence – at both the local (radius 800m) and the city-wide (radius n) scales of analysis.

Figure 88. The West Village, Manhattan – *historical threshold frequency* of a row house complex compared to the *current threshold frequency* for street segment sides. (c.2011)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.



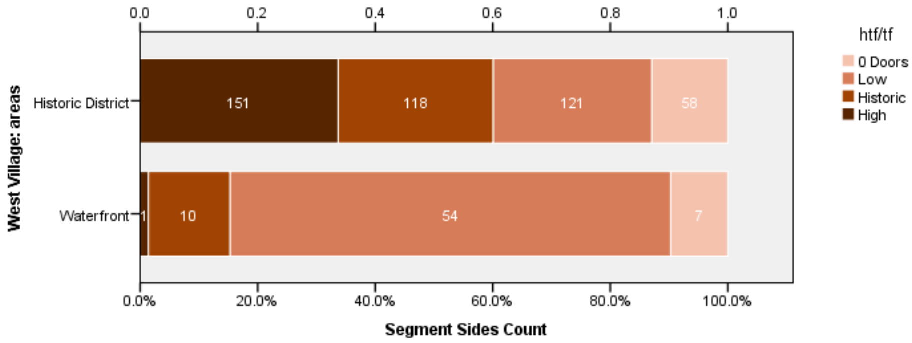
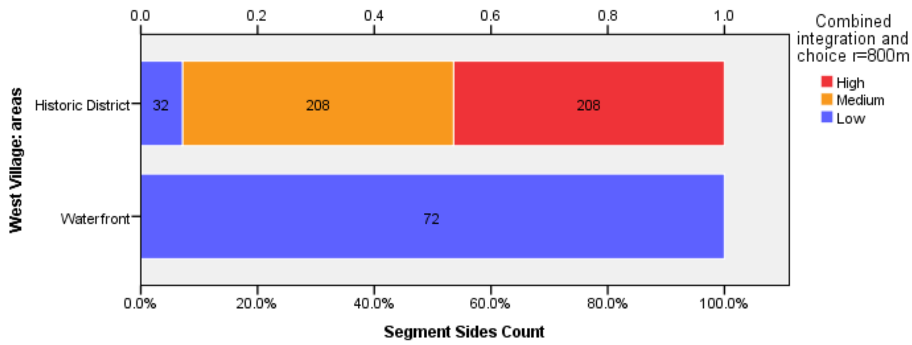


Figure 89. The West Village, Manhattan – Historic District and waterfront areas; *interface density*. (c.2011)



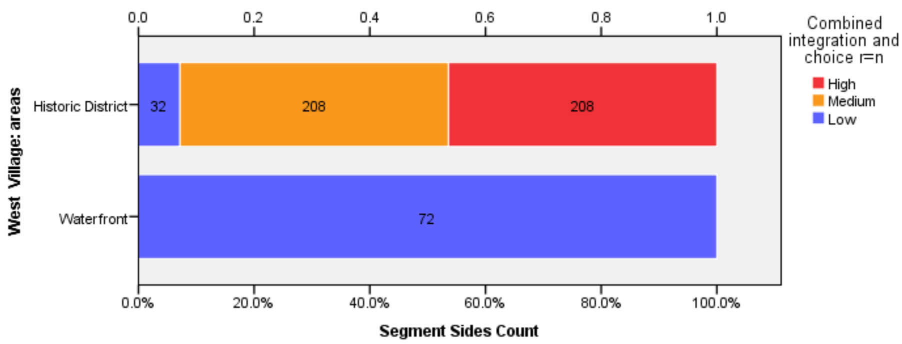


Figure 90. The West Village, Manhattan – Historic District and waterfront areas; *street segment syntax*. (c.2011)

Function and transition

The pedestrian experience of the street domain does not depend only on the density of the building-street interface: another important factor is the *type* of interface, or type of transition (Hanson, 2000). In the streets of the West Village, direct building entrances, stoops and blank doors[50] compose varying interior-exterior connections that are related to building function and building morphology. For instance, in a typical row house morphology one finds an ascending (or descending) stoop leading to a building doorstep. Access to a stoop is either implicitly restricted by the presence of a short iron crafted door or is completely open to pedestrians. The stoop's role can shift along a street from semi-private to semi-public, from entrance spaces to informal points of public encounter. On the other hand, buildings with a commercial use (including row houses) most commonly have a direct entrance to the street domain.

TABLE 28 Building thresholds	**Domestic**	**Commercial**	**Community**	**Other**
Direct	1953 67.3%	1652 94.5%	188 77.4%	521 92.9%
Indirect	947 32.7%	97 5.5%	55 22.6%	40 7.1%
Total Doors	2900 53.2%	1749 32.1%	243 4.4%	561 10.3%

Table 28. The West Village, Manhattan – building threshold use and type of transition. (c.2011)

Table 28 summarises primary and secondary thresholds according to land use. Uses with a more public character have direct entrances in the majority of cases (94.5% for 'commercial' uses, and 92.9% for 'other' – i.e., offices, hotels, or light industry). The percentage of secondary boundaries increases for community facilities (22.6%), as gated buildings such as schools are included here. Finally, residential buildings in the area frequently protect the private interior with additional steps: almost one out in three residential thresholds is a secondary entrance (32.7%).

[50] Blank doors refer to secondary building entrances like back doors and parking entrances, which allow no visual contact with the interior and which appear as a continuation of the wall surface.

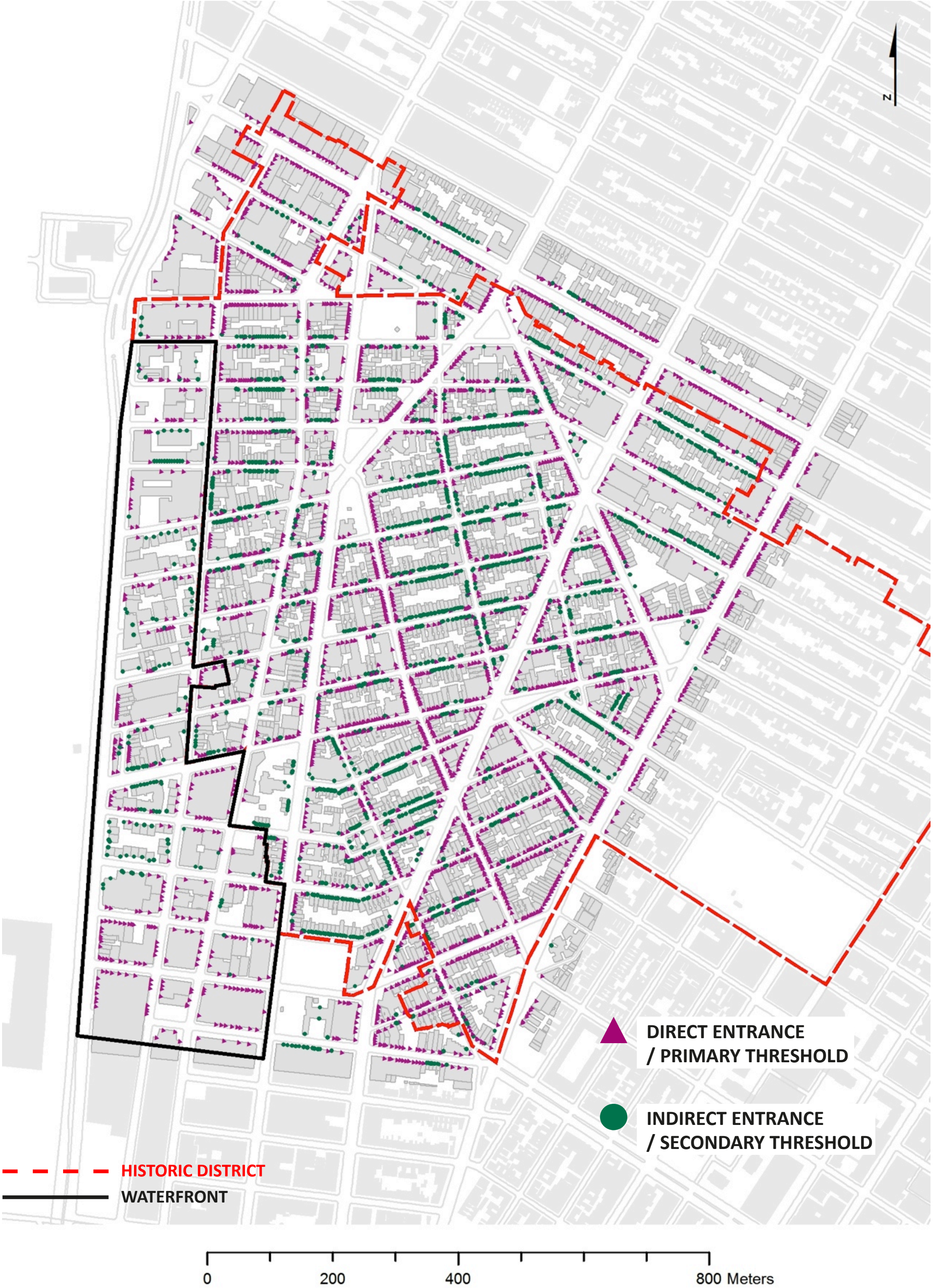


Figure 91. The West Village, Manhattan – type of interior-exterior transition; *direct* and *indirect* building thresholds. (c.2011)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

Recalling the land use allocation (Figure 81) and looking at the distribution of primary (direct) and secondary (indirect) thresholds in the West Village (Figure 91), it is understood that the main commercial streets of the area are highly constituted by direct entrances. Sixth Avenue and Bleecker Street are almost completely comprised of direct building-street relations. Seventh Avenue, Hudson and West 14th Streets similarly contain around 90% primary entrances (Table 29). However, each of these streets has a different profile overall. Street width, pavement width, building heights, treelines, as well as threshold density and potentials for pedestrian flow, are characteristics of the built environment that contribute to subtle variations in streetscapes. In this respect, the wider street domain seen in West 14th, Hudson Street and Seventh and Sixth Avenues – which accommodates in turn high volumes of vehicular traffic – in combination with the wide pavements lead in reality to a separation of the two sides of the street. In contrast, the narrow street domain in Bleecker creates the potential for probabilistic encounter with a higher opportunity for interaction across the street sides.

TABLE 29 Main streets	**Façades**	**Doors**	**Direct**	**Indirect**	**Blank**
Hudson St	124	251	226 90.0%	25 10.0%	11 4.4%
Seventh Av	79	162	148 91.4%	14 8.6%	19 11.7%
Sixth Av	101	224	219 97.8%	5 2.2%	4 1.8%
West 14th	134	303	276 91.1%	27 8.9%	28 9.2%
Bleecker St	123	244	244 100.0%	0 0.0%	3 1.2%

Table 29. The West Village, Manhattan – main streets and type of transition. (c.2011)

In general, direct building-street connections imply a more urban-like situation where pavement width primarily facilitates pedestrian traffic. In the smaller streets that transverse the main commercial connectors, and where residential uses are predominant, stoops intrude on the pavement width. In this case, a micromorphology that supports occupancy and probabilistic encounter is created (Figure 92). Finally, turning our attention to the presence of blank doors in the area, the different character of the waterfront becomes apparent once again: blank doors are almost three times more common (26.8%) in the waterfront than in the Historic District (7.1%). This implies higher building-street interaction for the historical row house blocks than the historically industrial waterfront.

Figure 92. The West Village, Manhattan – sidewalk micromorphology (c.2011)

Figure 93. The West Village, Manhattan – *historical threshold frequency* compared to the *current threshold frequency* considering only direct entrances. (c.2011)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

Overall, Section 6.3 provided an overview of the spatial and physical structure of the West Village. Analysis of the mapped building threshold survey shows that the area is found to present functional and morphological diversity in various scales: across the neighbourhood's sections, across streets, blocks, street segments, segment sides, and buildings, depending on the location of each within the West Village grid. Reading the syntax of the street network, analysis highlighted the main route arteries for the area, as well as the global or local importance of the streets. The north-south connections work as global routes, while the area's interstices compose the local character of the West Village. However, the urban scenery of the interstices themselves also varies. Moving from east to west within the area, the distinct character of the waterfront is traced on the built form properties, in terms both of land uses and building-street interfaces. In general, the waterfront area presents a sparser interface in terms of building thresholds, with land uses clustering across blocks. In contrast, a denser interface is observed in the Historic District, where disparate uses lie in close proximity to each other. Density, and functional diversity, within the Historic District accounts for a micromorphology that supports greater potential for probabilistic encounters and street liveability (Jacobs, 1961; Hanson and Hillier, 1987; Hanson, 2000).

Linking the history of the West Village presented in Section 6.2 of this chapter, with this final observation regarding the discrete street qualities of the waterfront and of the Historic District, it is understood that this schism between these two the West Village areas is persistent throughout time. Two main questions arise at this point:

- Firstly, whether there are any differences in the spatial properties of the street network that generated in the first place the different urban transformation processes for these two distinct Village parts; and
- what are the properties of the historical built form that allowed for street interface density and mixture to multiply over time.

In Chapter 6, Part B which follows, temporal analysis of the street network in relation to built form is employed in order to investigate firstly, the role, if any, of the street layout on urban transformation processes, and secondly, whether we can trace properties of building morphology that work probabilistically in the sense of supporting adaptability in change and the sustenance of a diverse micromorphology.

6B

Chapter six - The West Village, Manhattan

(Part B)

The second part of Chapter 6 looks back in time to explore the spatial and physical origins of this *embedded diversity*. In Section 6.4 temporal analysis of grid and built form transformations reveals (a) the role of street network configuration in distributing urban change, and (b) the way diversity is manifested not only across varying scales but also at many levels, primarily in the transformations of building morphologies and land uses. Section 6.5 summarises the findings from the research in the West Village.

6.4. Historical research

The following section will examine in greater detail the relationship between street configuration and built form. The study looks back in time in order to understand the *spatial* (street layout) and *physical* (building morphology) historical processes that shaped the West Village.

This comparative analysis of built form transformations and the street network covers the years from the early twentieth to the beginning of twenty-first centuries (c.1921, 1955, 2011). Data availability coincided with important historical turning points for the area's physical context, providing rich resources for temporal analysis. In the years between 1915 and 1930, the character of the West Village changed significantly. The influx of young artists into the area revived the picturesque qualities of the streetscape through piecemeal transformations of row houses and tenements (Dolkart, 2009). In the subsequent decades, increased market investment in the West Village led to the redesign of historical urban houses in order to achieve higher rents (*ibid.*).

A consideration of urban transformations between c.1921 and c.1955 is important for understanding the interplay of street network and built form. In 1969 the area became designated as Historic District and therefore conservation became an additional factor in the processes of built form continuity and change. On the other hand, the next period studied (1955 till present) shows the challenges the historical built form came to face with the implementation of the 1961 Zoning Act which allowed commercial uses to diffuse into the formerly wholly residential streets of the West Village.

The sources used for the analysis were as follows:

- The record of building uses of this period (c.1921) was obtained from the Bromley & Co. Fire Insurance Maps *'Atlas of the City of New York, Manhattan Island'*.
- Maps were obtained from the Municipal Archives at the Department of Records in New York City during a research trip to Manhattan in 2011 (see Figure 94).
- For consistency, the Bromley & Co. Atlas of c.1955 was used for records of the post-war years.
- For c.2011/2013, an on-site survey, Google maps and New York City Open Data were used as data resources. All data were transferred to datasets, manually digitised and mapped in ArcGIS Software.

Analysis in this section will begin with the study of grid transformations in relation to built form changes. The second part looks at the properties of the West Village's historical buildings (row houses and tenements) in terms of the building-street interface and its adaptability to change.

6.4.1. Urban transformations

In 1921, George W. and Walter S. Bromley recorded 3,834 building façades overlooking the West Village streets[51]. Only three decades later, the surveyors found this number had decreased by approximately one thousand: the total number of façades mapped in 1955 is 2,881. Until the present day, the number of building façades in the West Village remains similar (2,848 façades in 2013). A comparative study of the three snapshots in time reveals further information regarding the type and location of these changes in built form. The Bromley Atlases also provide information regarding building heights, meaning it was possible when comparing the maps to ascertain from the plot outline and building height whether a building had been demolished or altered. It has to be clarified that alterations here refer to the built volume in terms of size and not to architectural elements or building use. For instance, alterations in façade width were noted when two row houses were combined into one, as well as alterations in building height when storeys were added in the existing building footprint.

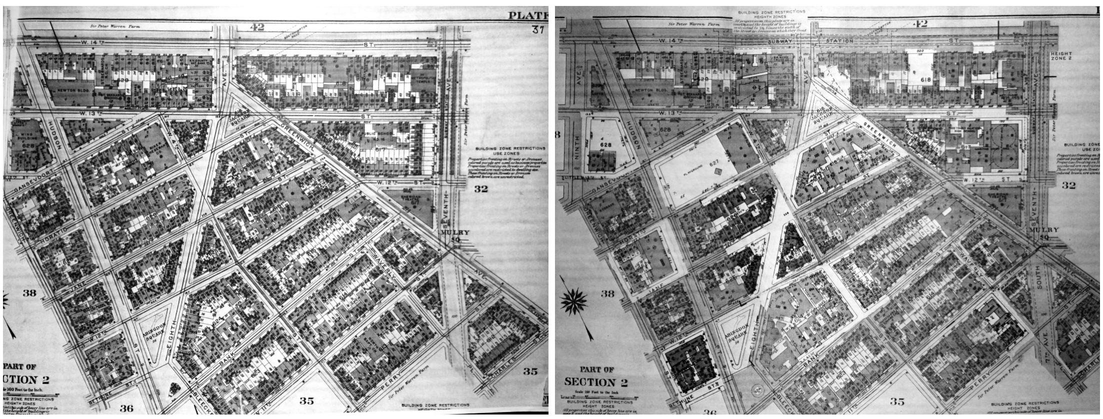


Figure 94. The West Village, Manhattan – detail from *Bromley & Co. Fire Insurance Maps 'Atlas of the City of New York, Manhattan Island',* c.1921 (left) and 1955 (right).

© Municipal Archives, Department of Records, New York City.

[51] The precise number of façades was counted by the author after the aforementioned data processing: each mapped building in the historical Bromley & Co. maps was 're-mapped' over the digital 'basemap' of the current building footprints.

c.1921-1955

c.1955-2013

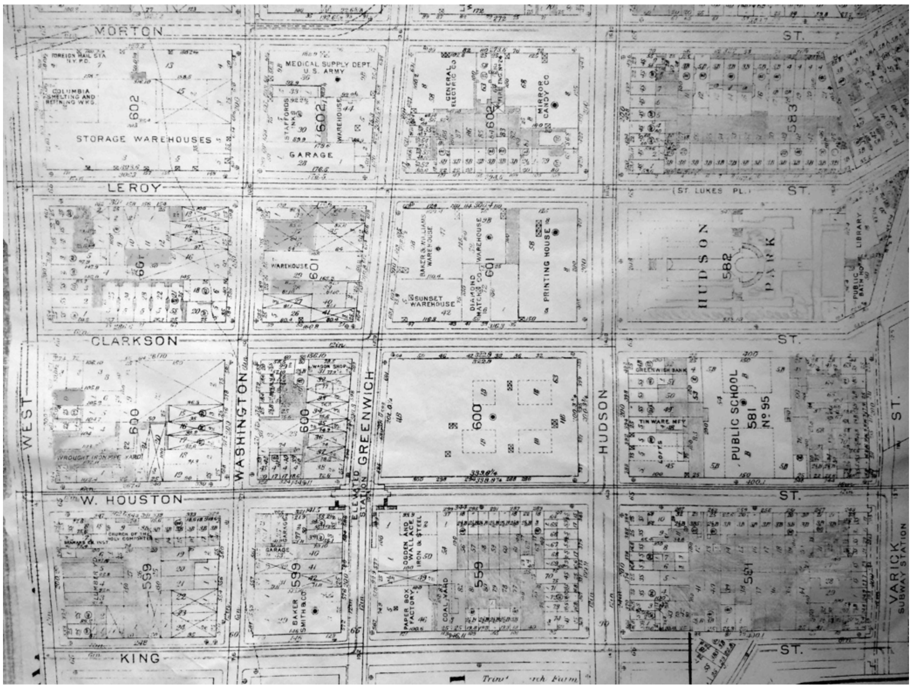
Figure 95. The West Village, Manhattan – built form transformations, c.1921-1955 and c.1955-2013.

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

A comparative analysis for the periods between c.1921-1955 and c.1955-2013 is illustrated in Figure 95, which maps the location and classification of building façades as points. Points are coloured in grey when the same building remains; in black if this building was demolished in the later period; and in red where the building has been added in a later period and was not present in the earlier years. Here, the significantly higher number of demolitions in the years between 1921 and 1955 is obvious. The signs of urbanisation can also be distinguished in the mapped incidents of changes. Firstly, the long lines of demolitions (black) and building additions (red) along the Sixth and Seventh Avenues illustrate the impact stemming from the streets' extension – and their subsequent increased centrality – in the early 1900s. Secondly, the high number of demolitions in the northeast part of the West Village reveals the increasing commercial pressures arising from the flourishing Broadway to the east. Moreover, it is observed that during the first studied period the character of the west waterfront changed significantly. Since the early years of twentieth century the Hudson River had become the locus for maritime commerce. With the construction of the Gansevoort and Chelsea Piers the area's popularity for transportation-related commerce increased and attracted storage warehouses and light industries (Landmarks Preservation Commission Report, 110-112 Horatio Street, p.1). Block fronts of row houses and tenements were gradually removed, especially in the southern part of the waterfront. Note for instance in Figure 96 the construction of the Union Terminal Freight Station (along with parking and garages in the near blocks) and of the U.S. Appraisers Store. These particular redevelopments prompted altogether around 140 building demolitions. Finally, slum clearance in the area had begun in the 1920s, also causing several demolitions (Jacobs, 1961, p.280). Many of the cleared sites were built-up with post-modern redevelopments in the following period (Figure 95, c.1955-2013; red points along and nearby Washington Street).

Tables 30 and 31 quantify results regarding building demolitions and alterations in order to compare these transformations within the distinct sections of the Village.[52] When reading the Tables, two main points are highlighted. Firstly, the results reveal the scale of urban transformations on the waterfront between c.1921-1955: only one quarter of the area escaped demolition. In general, during the first half of the twentieth century, one in two buildings were demolished in the parts outside the Historic District. Within the Historic District 70% of the building stock survived until c.1955. During the

[52] The distinct parts were highlighted in the previous section with analysis of the current situation: the Historic District, the street sections outside the Historic District overall and the west waterfront in particular.



c.1921

c.1955

Figure 96. The West Village, Manhattan – block redevelopments; Union Terminal Freight Station and U.S. Appraises Stores.

Bromley & Co. Fire Insurance Maps 'Atlas of the City of New York, Manhattan Island'.

TABLE 30 c.1921-55	**Façades**	**Demolitions**	**Alterations**
Historic District	2916	836 28.7%	181 6.2%
Non-historical	918	603 65.7%	36 3.9%
Waterfront	510	375 73.5%	3 0.6%
Total	3834	1439 37.5%	217 5.7%

Table 30. The West Village, Manhattan – Historic District v. west waterfront; built form transformations. (c.1921-1955)

TABLE 31 c.1955-2013	**Façades**	**Demolitions**	**Alterations**
Historic District	2383	132 5.5%	104 4.4%
Non-historical	498	132 26.5%	34 6.8%
Waterfront	238	92 38.6%	20 8.4%
Total	2881	264 9.2%	138 4.8%

Table 31. The West Village, Manhattan – Historic District v. west waterfront; built form transformations. (c.1955-2013)

second half of the century and until the early 2000s demolitions within the West Village sections protected by Historic District status were reduced to just 5.5%. Secondly, the great challenge during these years for the buildings to adapt in the changing socio-economic context of the West Village is notable: the majority of buildings altered in both periods were located within the Historic District (around 85% of total alterations in the West Village for the first period and 75% for the second). At the same time, while alterations increased almost seven-fold in the waterfront itself (from 0.6% to 8.4% – still low in number), a large part – almost 40% – of the waterfront was cleared.

These two main observations deriving from Tables 30 and 31 lead back to the basic questions raised in this section. The first question pondered the potential role of street configuration in urban transformation processes; we will explore sections outside the Historic District – which experienced a significant number of demolitions over time – to see whether they present historically different spatial properties in comparison to the areas within the District. The second question queried the challenges that the historical built form came to face over time: of specific interest here will be the unique properties of the row house which not only engendered its adaptability to change, but also fostered the creation of the dense and diverse street micromorphology described in Section 6.3.

The network properties of the West Village historical grid for c.1891, 1921, 1955 and 2011 are illustrated in Figure 97. Comparing the 1891 and 1921 configurations, the effect on the area's centrality after the street extensions of the early twentieth century can be seen. The Village's integration core is formed around the intersection where the extension of Seventh Avenue meets Christopher Street. During all studied periods and across all scales, the lower syntactical significance of the west waterfront is observed (blue colour range). The measure of *combined integration and choice* provides an overview of the network properties for each period. However, due to the different size of historical street networks this measure cannot be used to directly compare syntactical values. In order to compare systems with different sizes (different segment number and different system depth), such as these historical maps, *normalised syntactical measures* are required (Hillier et al., 2012). Table 36 summarises the mean values of *normalised segment angular choice* (NACH) and *integration* (NAIN) for all studied periods. Moreover, local (radius 800m) and city-wide (radius n) historical values are plotted together in Figure 98. In general, the West Village remains overall well-connected within the Manhattan grid over time.

The detailed record of the Bromley Atlases provided another very important set of data. Land uses for 1921 and 1955 were retrieved from these Fire Insurance Maps and were related to the street network properties of each time period. This allowed further examination of the role of street network in distributing urban change. One of the challenges of historical research is that observations need to stretch over time: historical research aims to understand *processes* and not only phenomena (Griffiths, 2010). Results from the following comparative analysis of syntactical values and historical land uses for the West Village show indeed that 'multiplier effects' (see Hillier, 2002, p.153) have developed and can be traced when studied over time.

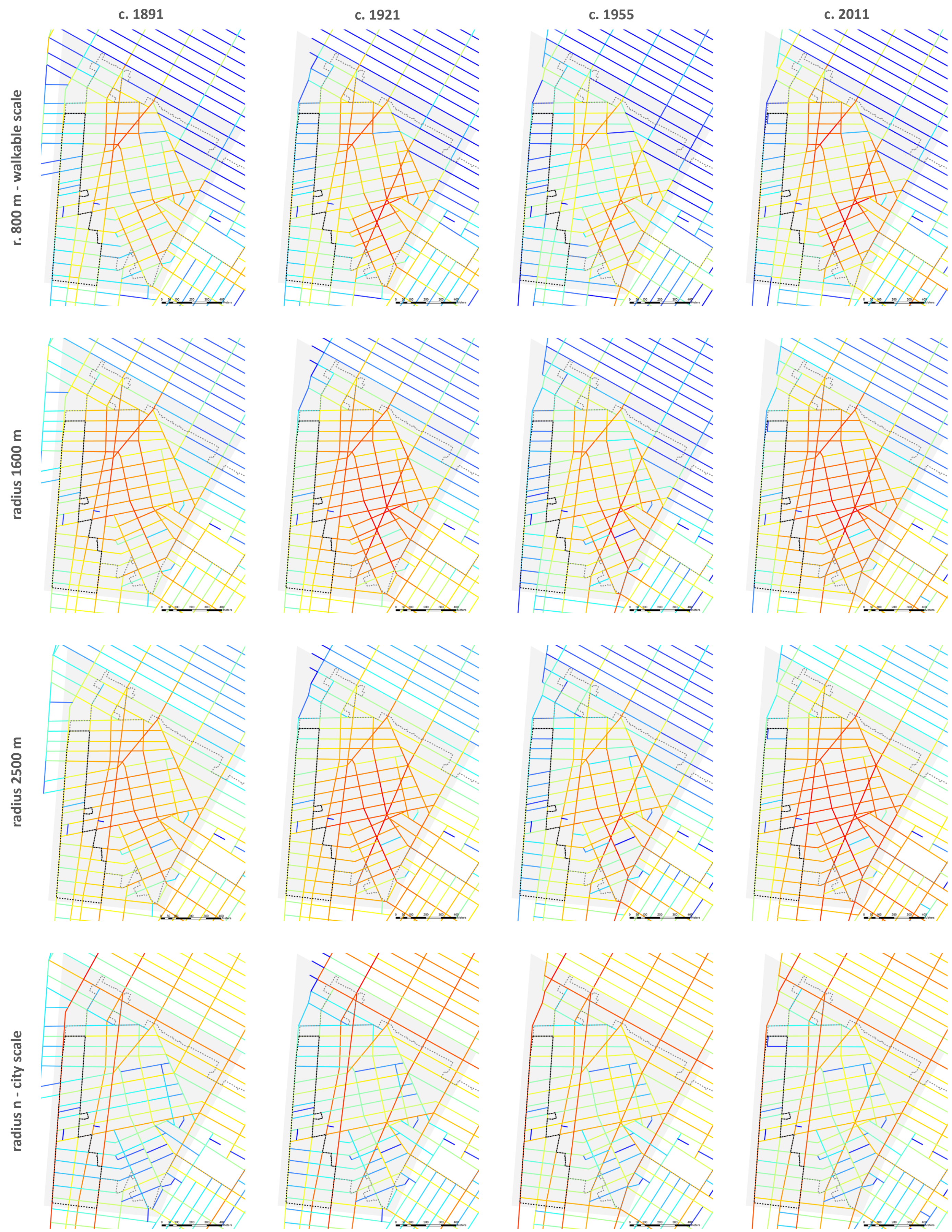


TABLE 32 c.1891	INT_CH R800	INT_CH R1000	INT_CH R1600	INT_CH R2000	INT_CH R2500	INT_CH Rn
Hudson St	50.43	86.88	242.63	377.94	571.00	20686.34
Seventh Av	23.03	38.58	138.46	241.30	399.63	15693.72
Sixth Av	40.51	70.18	187.98	308.83	503.66	17162.71
West 14th	11.90	19.59	96.03	173.52	292.83	18210.79
Bleecker St	59.19	97.38	262.07	407.63	616.04	12735.56

TABLE 33 c.1921	INT_CH R800	INT_CH R1000	INT_CH R1600	INT_CH R2000	INT_CH R2500	INT_CH Rn
Hudson St	50.43	87.15	249.25	387.13	581.89	21666.29
Seventh Av	73.88	119.57	320.15	493.89	749.83	20314.24
Sixth Av	40.95	71.96	205.38	342.22	554.60	17672.84
West 14th	13.88	22.63	91.44	161.15	277.88	20857.43
Bleecker St	81.96	134.74	347.38	526.13	763.82	14153.44

TABLE 34 c.1955	INT_CH R800	INT_CH R1000	INT_CH R1600	INT_CH R2000	INT_CH R2500	INT_CH Rn
Hudson St	1469.53	4652.44	45484.98	125488.37	332621.51	21548.85
Seventh Av	2763.04	8470.22	83775.90	234408.22	637694.05	18845.66
Sixth Av	2235.45	6789.73	62942.39	187126.99	540688.42	20512.89
West 14th	171.33	429.26	5749.79	15947.03	49269.71	20911.60
Bleecker St	3591.90	10919.30	100310.82	276592.93	708337.48	12891.63

TABLE 35 c.2011	INT_CH R800	INT_CH R1000	INT_CH R1600	INT_CH R2000	INT_CH R2500	INT_CH Rn
Hudson St	50.43	87.09	247.83	382.22	575.80	22021.11
Seventh Av	68.58	112.02	295.23	458.96	695.85	19269.28
Sixth Av	35.42	63.06	183.43	308.98	507.65	17821.38
West 14th	14.38	24.90	98.88	172.41	295.14	21038.98
Bleecker St	67.77	112.57	306.72	476.00	696.86	12924.51

WATERFRONT

HISTORIC DISTRICT

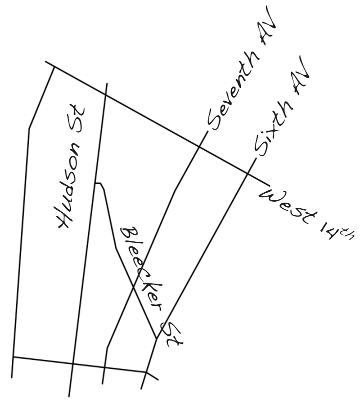


Figure 97. The West Village, Manhattan – grid transformations, c.1891, 1921, 1955 and 2011.

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

TABLE 36 Mean values for the normalised measures of choice (NACH) and integration (NAIN)	**c.1891**	**c.1921**	**c.1955**	**c.2011**
NACH_Rn	1.18	1.16	1.20	1.19
NACH_R2500	1.15	1.15	1.16	1.15
NACH_R2000	1.13	1.13	1.14	1.13
NACH_R1600	1.10	1.10	1.11	1.11
NACH_R1000	0.99	1.01	1.02	1.00
NACH_R800	0.89	0.92	0.93	0.91
NAIN_Rn	2.38	2.23	2.32	2.28
NAIN_R2500	1.87	1.92	1.93	1.89
NAIN_R2000	1.82	1.86	1.87	1.84
NAIN_R1600	1.76	1.80	1.81	1.78
NAIN_R1000	1.68	1.72	1.73	1.71
NAIN_R800	1.65	1.68	1.69	1.68

Table 36. The West Village, Manhattan – historical street configuration; syntactical values for the measures of *normalised choice* (NACH) and *normalised integration* (NAIN) for radii n, 2500 m, 2000 m, 1600 m, 1000 m and 800 m. (c.1891-2011)

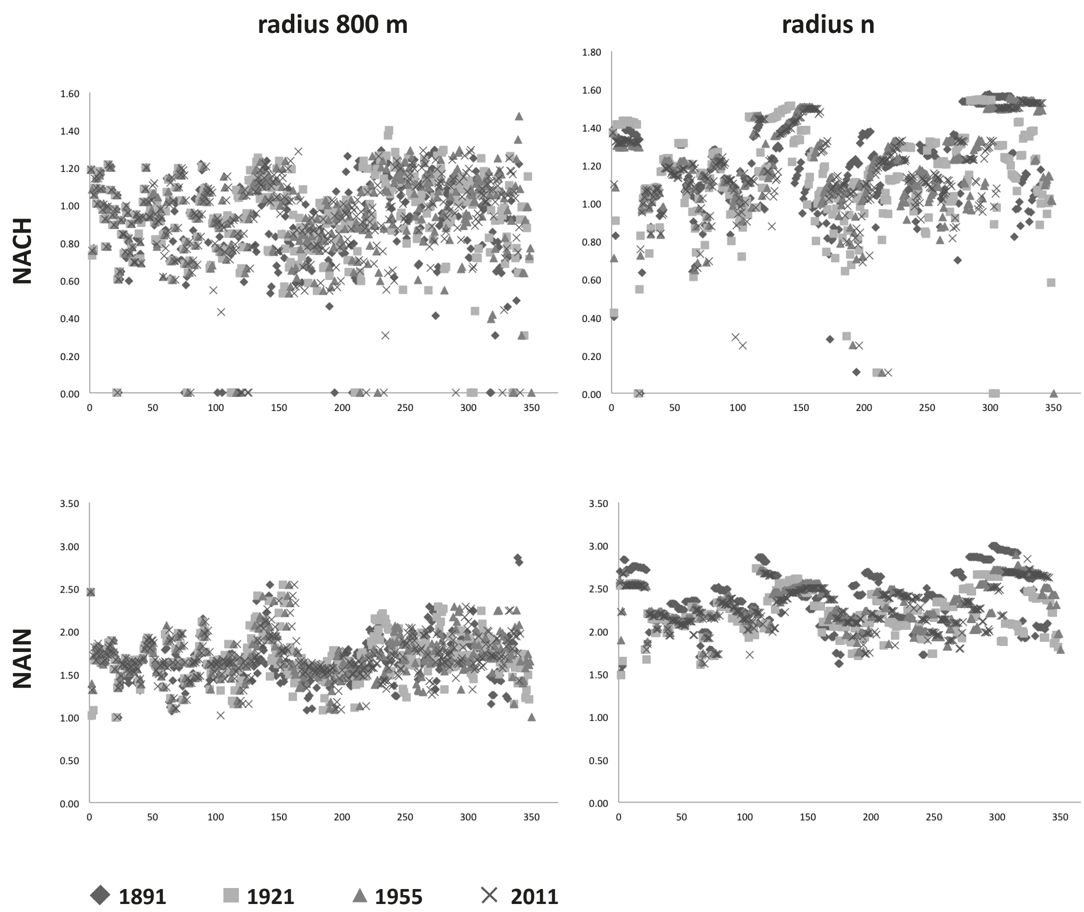


Figure 98. The West Village, Manhattan – the historical grids: syntax.

Charts show values for the plot for street segment syntactical values for *normalised choice* and *integration*.

In studying the allocation of building uses in 1921 (Figure 99) the main commercial routes in the area can again be identified. Hudson Street and Sixth Avenues act as city-wide commercial connections. The higher syntactical values (see earlier in Figure 94 at a city-wide scale, radius n; Tables 32, 33, 34 and 35) for these north-south arteries indicate that these streets absorbed global traffic, acting consequently as a lively barrier that protected the primarily residential interstices of the Village grid from the forces of urbanisation. In the local context of the network, Bleecker Street appears

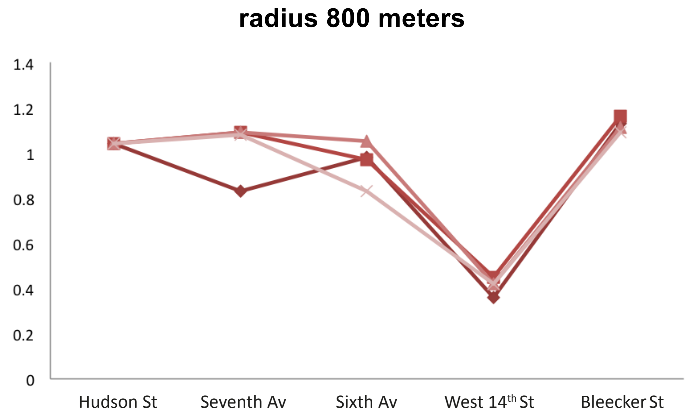
Figure 99. The West Village, Manhattan – the historical building uses.

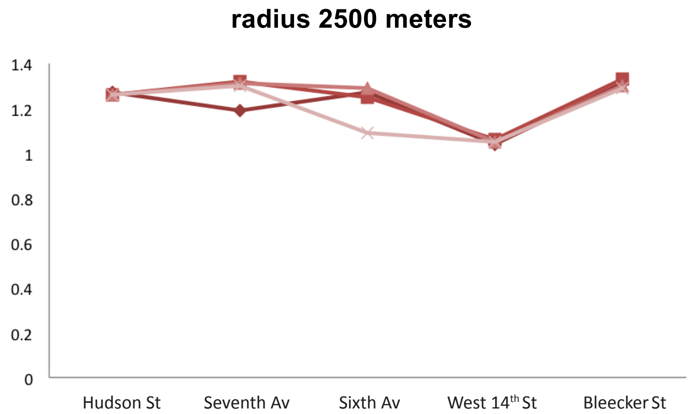
Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

to retain its historical importance within the West Village.[53] Again, here the values of *normalised choice* and *integration* measures allow for a historical comparison of each street's syntactical properties. Looking at the diagrams in Figures 100 and 101 a number of observations can be made. As expected, Seventh and Sixth Avenues are identified as the streets with the highest change over time. Additionally, Bleecker Street remains historically an important *local* street for the West Village. Note that Bleecker Street appears packed in commercial uses in all studied periods (Figures 81 and 99). At the same time, Bleecker is the least significant route for city-wide connections over time. The opposite fact stands for West 14th which appears consistently more significant at the city scale. Tables 32-35 provide more detailed information regarding the syntactical significance of those main streets within the specific context of each historical map.

Another point of interest in the historical building use map of 1921 is that Seventh Avenue does not seem to have a strongly defined functional purpose in terms of land uses (Figure 99). The street interface appears rather sparse in parts of the street, with few buildings in comparison to other main routes. Moreover, this sparseness in combination with a mixture, and randomness, in land uses constitutes a weak character regarding the street's functional purpose. If looking solely at the syntactical importance of Seventh Avenue within the 1921 street network this would be unexpected, since the street is one of the most integrated parts – especially at the local scale (Figure 102). However, going back to the 1891 map we observe that Seventh Avenue was present only in the northern part of the West Village (while in 1921 Hudson and Sixth remain the same length as seen in 1891). Therefore, it is apparent that multiplier effects from the recent Seventh extension (1914) would not manifest until later years. As anticipated, the record of land uses for c.1955 shows a better-defined, predominately non-domestic street interface.

[53] Lockwood (1972, p.2) mentions Bleecker Street as an early known part of Greenwich Village in the early nineteenth century, before Manhattan started to take shape as a great city, and when Canal Street was still a canal.





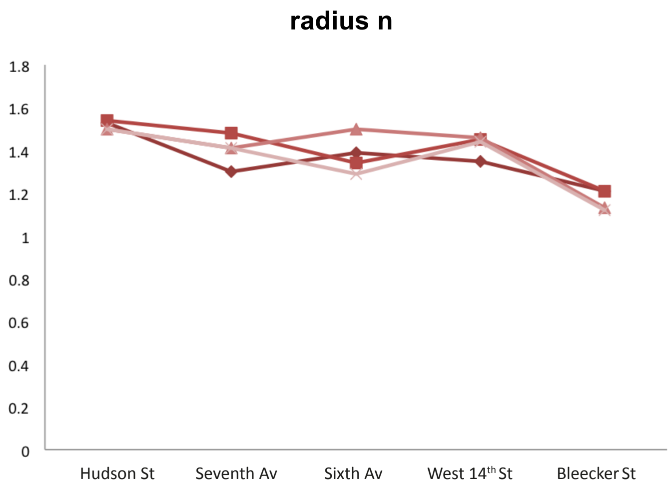
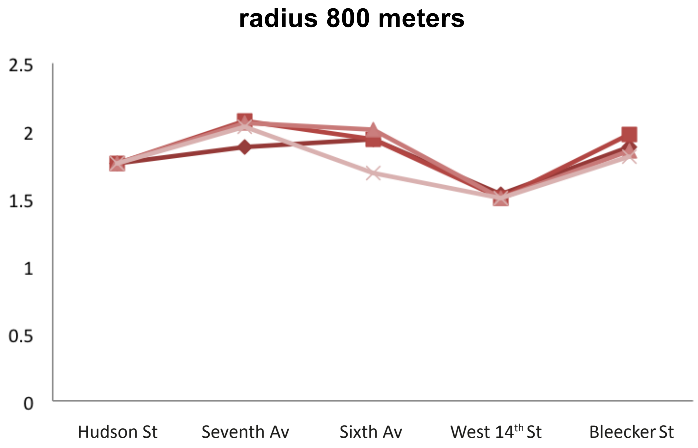
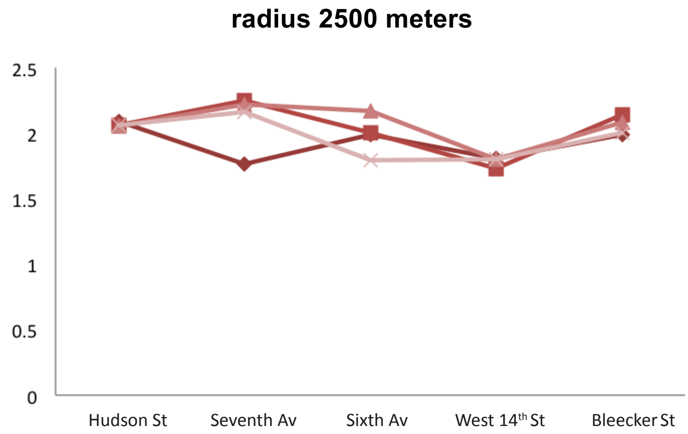


Figure 100. The West Village, Manhattan – main streets and syntax.

Charts show a plot of mean values for *normalised choice*.





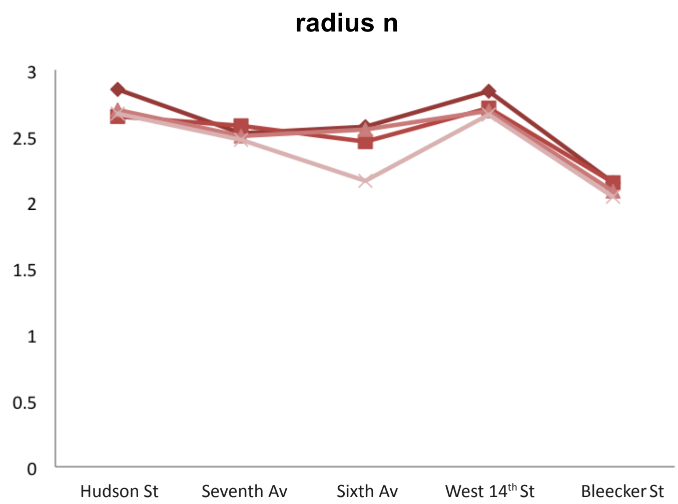


Figure 101. The West Village, Manhattan – main streets and syntax.

Charts show a plot of mean values for *normalised integration*.

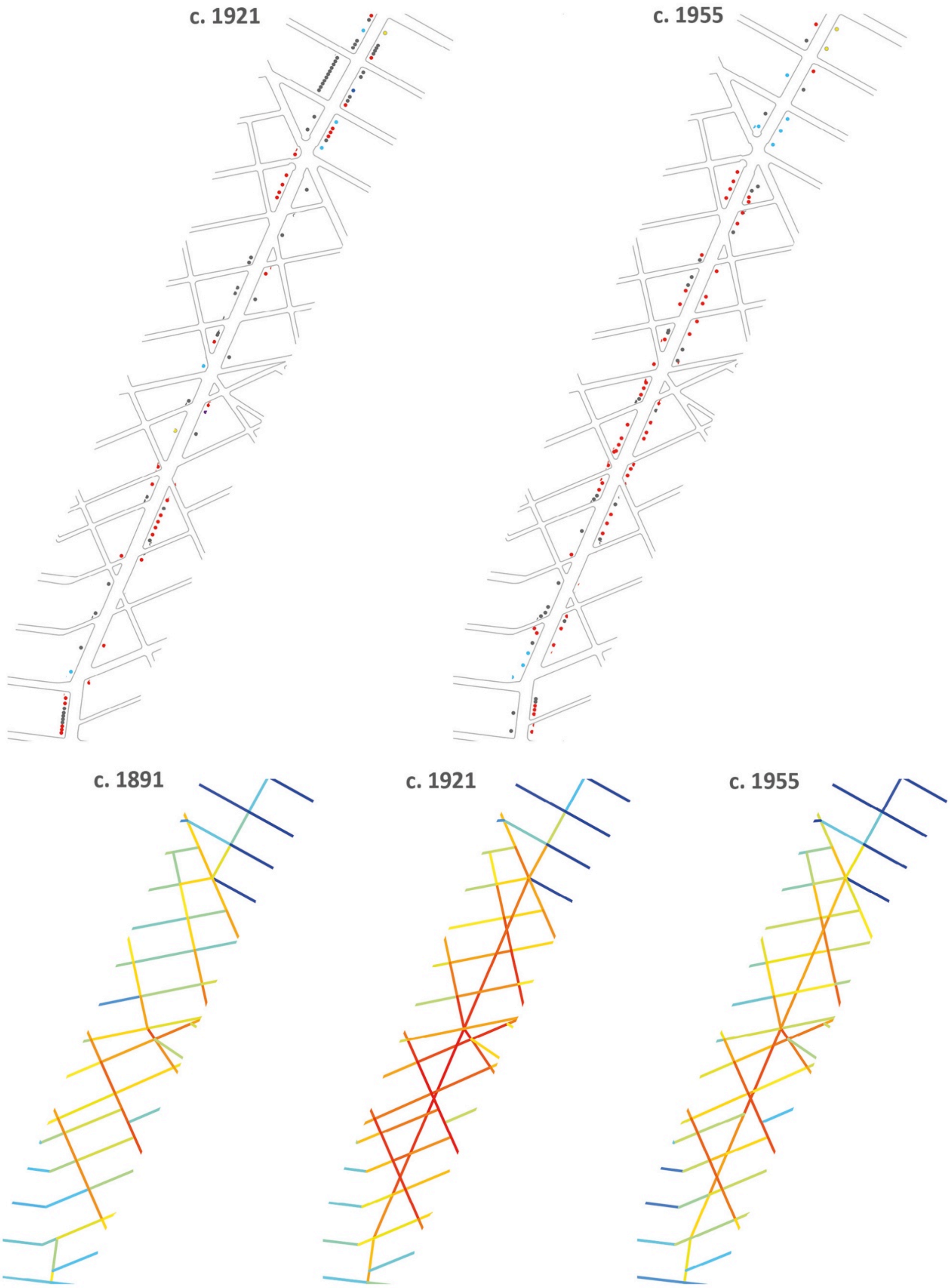


Figure 102. The West Village, Manhattan – Seventh Avenue.

Showing historical building uses (top) and street segment syntactical properties for the measure of *combined integration and choice* for radius 800 m.

TABLE 37 c.1921	Façades	Domestic	Commer.	Commer/ Res	Commun.	Other	Warehouse
Historic District	2916	1491 51.1%	208 7.1%	1021 35.0%	64 2.2%	58 2.0%	74 2.5%
Non-historical	918	381 41.5%	68 7.4%	289 31.5%	19 2.1%	62 6.7%	99 10.8%
Waterfront	510	217 42.5%	24 4.7%	125 24.5%	8 1.6%	48 9.4%	88 17.2%
Total	3834						

Table 37. The West Village, Manhattan – historical building uses. (c.1921)

TABLE 38 c.1955	Façades	Domestic	Commer.	Commer/ Res	Commun.	Other	Warehouse
Historic District	2383	1261 52.9%	294 12.3%	633 26.6%	79 3.3%	41 1.7%	75 3.1%
Non-historical	498	222 44.6%	71 14.3%	99 19.9%	8 1.6%	44 8.8%	54 10.8%
Waterfront	238	123 51.7%	13 5.5%	22 9.2%	2 0.8%	32 13.4%	46 19.3%
Total	2881						

Table 38. The West Village, Manhattan – historical building uses. (c.1955)

Finally, in viewing the overall image of historical street network properties and land use allocation we can reach some general observations regarding the surviving historical and non-Historic Districts of the West Village. The waterfront area presents consistently low (blue colour range) syntactical values over time (Figure 97). In contrast, the heart of the Historic District becomes steadily more integrated (red) as a result of the growing importance of the Seventh Avenue and Christopher Street intersection. Commercial uses are gradually pushed away from the waterfront (Tables 37 and 38: the number of building units with commercial use are reduced to half between 1921 and 1955) towards the lower eastern Village part where Bleecker Street (local) meets the Seventh (semi-local) and Sixth Avenues (city-wide) (Figure 96). While the lower west part was being widely redeveloped, a consistent level of density and of the mixture of uses persisted within the Historic District.

In other words, space has not created equal potentials across the whole Village. It seems that where configurational properties are historically weaker, as in the case of the west waterfront blocks, the persistence of the built form was threatened, by demolition but also by the consequences of economic mixing and functional prosperity. In the mid-twentieth century, these sites of relatively weak 'urban character' became objects of enquiry for urban renewal plans[54]. Redevelopments referred to 'rehabilitation' through the conversion of buildings such as factories and warehouses into multi-dwellings (as in the case of block No 638; buildings converted in 1978), or to extended demolitions and the replacement of whole blocks with post-modern housing schemes (as happened in the block bounded by Barrow, Morton and Washington Streets, where construction started in 1969 and was completed in 1974) (Figure 103). One way or another, these urban renewal projects aimed to 'restore' the streetscape through the removal of industry from the area.

Figure 103. The West Village, Manhattan – block scale redevelopments at the waterfront area.

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

[54] It was such a significant redevelopment proposal project that Jane Jacobs personally fought against in 1961. At that time Mayor Robert Wagner declared the waterfront sites bounded by West, Christopher, Hudson and West 11th Streets, along with the blocks of Morton and Barrow facing West St, as a prospective urban renewal area. In her book Jacobs justifies her opposition to this mono-functional large-scale urbanism. Land uses recorded for 1921 and 1955 visualise the *time-spread* 'ballet of Hudson Street' as described by the author (1961, p.153).

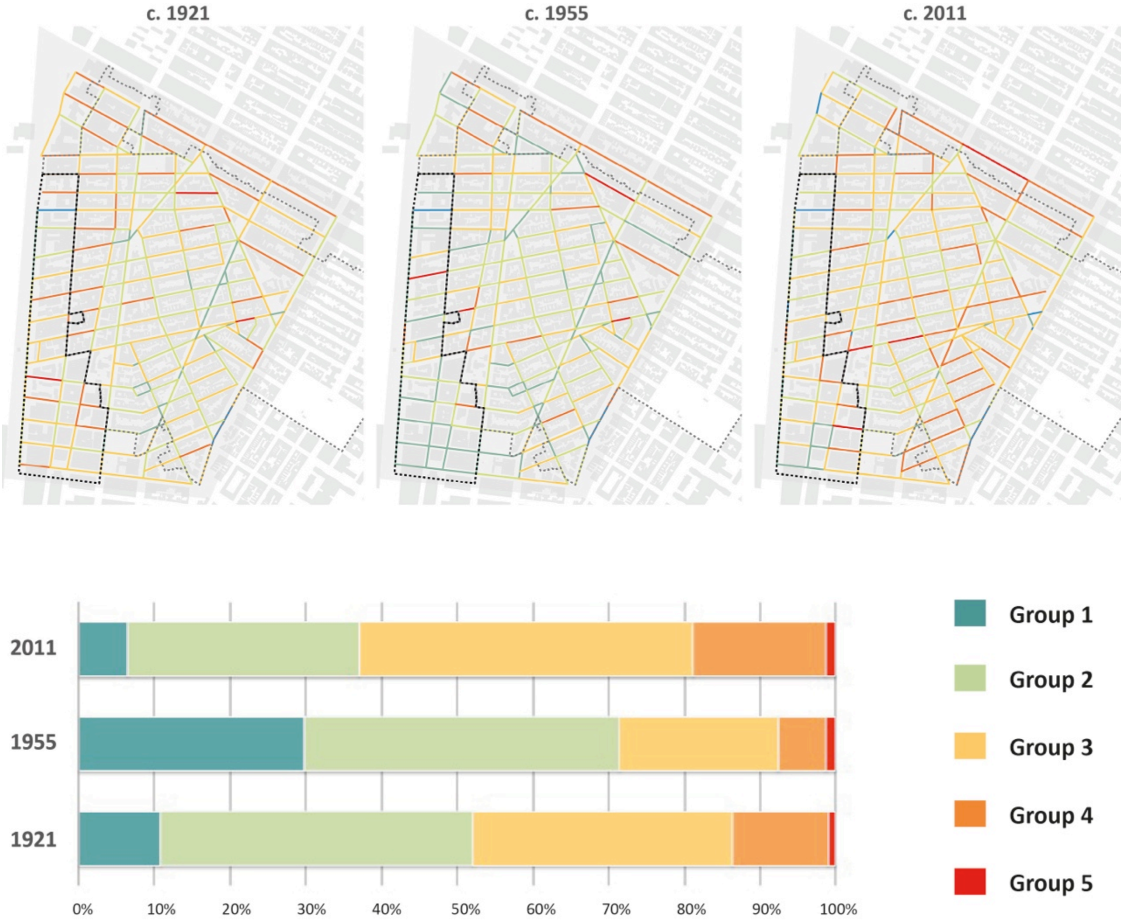


Figure 104. The West Village, Manhattan – historical land use mixture for street segments for c.1921, 1955 and 2011.

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

A temporal analysis of shifts in the functional mixture seen in the West Village can provide further insights concerning urban change patterns in the area. Similar to the analytical approach applied in Islington, street segments were grouped according to the degree they displayed a mixture of use types. Group 1 represents segments with only one primary use and Group 5 represents the highest degree of mixing. The existence of an additional group of segment scale use diversity (Group 5) – whereas in Islington there were only 4 – is justified by the presence of warehouses in the area. To accomplish historical comparison of uses in the West Village, it was essential to consider these uses separately (based on the Bromley & Co. Atlases). Figure 104 shows proportions for each group for c.1921, 1955 and 2011. A comparison between the situations in 1921 and 1955 reveals the impact of the changing character of the waterfront. In 1955 approximately 70% of segments have only one or two primary uses. This equates to a 20% increase from the previous period when segments a lower functional diversity (Groups 1 and 2) were roughly the same in number as more mixed ones (Groups 3, 4 and 5 – considering that Group 5 is a rarity). Had the rest of the West Village continued at this pace, and in the same direction towards a lower mix-use character, it is likely that the neighbourhood today would be far removed from its vibrant past. The Historic District designation in 1969, stimulated by Jacobs' concerns and actions, turns out to be a pivotal point in the area's history. The record of mixed-uses for 2011 shows how the trend seen in the previous period was overturned. Almost reversing the 1955 ratios, the beginning of the twenty-first century found the West Village with high land use mixing across 65% of its street segments. It seems that the protected integrated core (Figure 97) generated over time a greater diversity in uses in all parts of the West Village.

The following analysis studies the physical properties of historical built form that allowed for *building-scale diversity* (morphology and use) to develop. The section discusses the *flexibility* of the row house morphology in responding to shifting requirements over time. Again focusing on the ground floor and the building-street interface, the micromorphology of the Historic District streetscape is described.

6.4.2. The historical built form

Flexibility

The West Village is a testament to the great stylistic variety of New York's row house architecture. From early modest precedents to grander blocks, the area includes the majority of recognisable architectural styles as well as transitional stylistic hybrids. Row houses were obliged to adapt to a variety of requirements in response to different lifestyles and growing densities in the West Village

Over time, the row house typology responded to the shifting urban challenges of an increasing population, new building codes, the changing costs of refurbishment, varying expectations of living arrangements (single living, work-live spaces etc.) and shifts in the social classes of inhabitants, with transformations at many levels:

changes in building 'use', modifications to the building volume, floor plan re-organisation, and adaptations to the façade. Dolkart (2009) discusses how in the early years of twentieth century, single-family row houses were transformed into multi-dwellings, into apartment studios for young professionals and artists, or into mixed-use buildings with stores on the basement, providing solutions to the various demands of the housing market. Howard Davis points out that the *tenement* building as well originates from the row house typology (Davis, 2006, p.151-153; also in Plunz, 1990, p.13). The author explains that in the case of row houses *'the building culture allowed these transformations to take place'*, and goes on to argue that that *'tradition and innovation are not contradictory but complementary concepts'*, in that they inform one another. Here the analysis aims to understand how this is achieved in terms of building morphology. The following paragraphs summarise examples of the various ways in which the row house typology adjusted to continuously shifting needs over time. Space syntax analysis of the building interior is employed to bring to the fore the workings of the spatial layout that supported flexibility in the interior re-organisation via the expansion, merging or breaking up of existing spaces. The aim is to retrieve any traceable potential design features that enabled adaptations at many scales (from the building up to the whole block).

Figure 105 shows a row house type transformation from single- to multi-occupancy (Davis, 2006, p.152). Space syntax analysis of the floor plan organisation using Depthmap software (Turner, 2001) reveals aspects of a flexible spatial layout. Spaces are organised based on axes of symmetry. This enhanced the configuration's adaptability to changeable domestic needs: symmetrical distribution of integration values indicates the equal handling of units in the front and rear of the house, allowing their functional purpose to be interchangeable over time. The main staircase and corridor remains in all versions the integration core (red) of the plan, providing access to symmetrically integrated rooms, and, eventually, to up to four symmetrically organised residential units per floor.

The fact that plot and floor plan potentials were challenged to the extreme did not assure high-standard living conditions. As population densities grew, the tenement building emerged as a response to the demand for low-cost housing design. Tenements suffered from an extreme lack of light and ventilation. Buildings were crammed within the restraints of a 25-by-100-foot lot, with almost 90 per cent coverage and with heights reaching five or six storeys. Plots were so overbuilt and

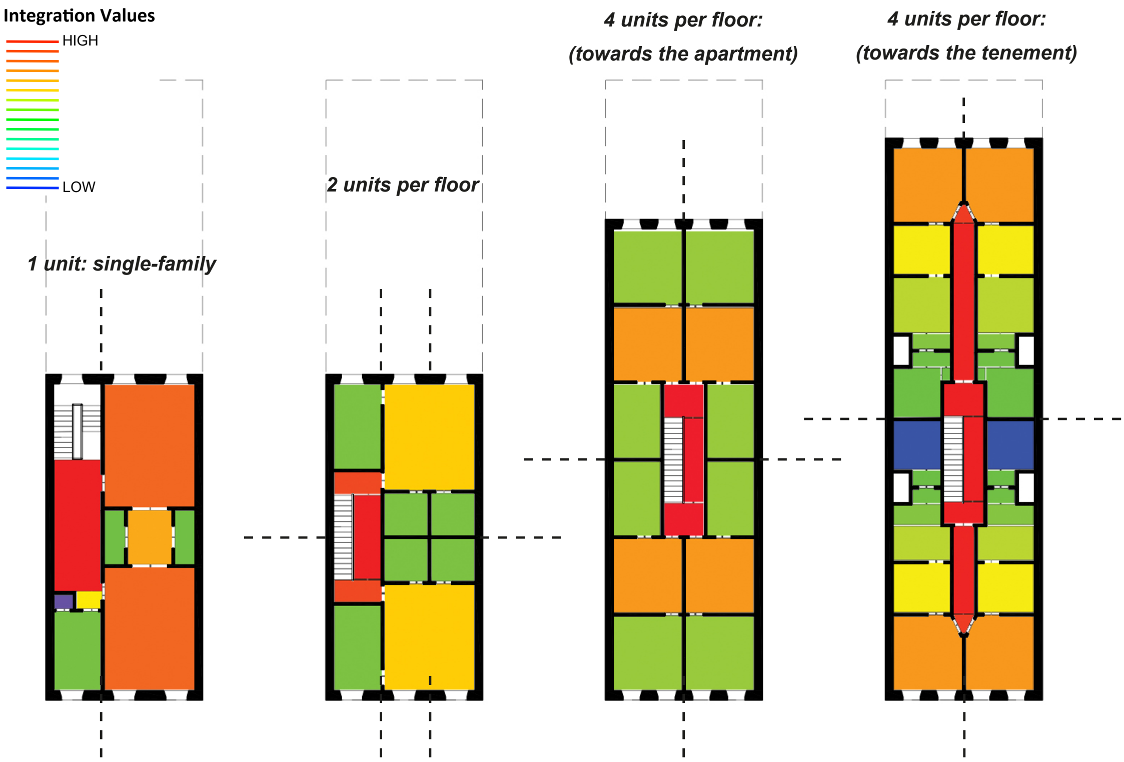


Figure 105. New York row house: the typology's transformation from single- to multi-occupancy.

Showing the building layout superimposed on syntactical values of integration. (Floor plans redrawn based on Davis, 2006, p.152).

floors so packed with sequential rooms that the name 'railroad flats' was used for the longest versions (Plunz, 1990, p. 13; see also Figure 106). By the 1850s the 'tenement problem' was already a fact. The Tenement House Act of 1867 introduced a series of legislative efforts to improve housing for the poor. However, real estate interests often impeded these new provisions. The 'dumb-bell' tenement type for example (Figures 106, 107) is a by-product of these law/market negotiations: while the Tenement House Act of 1879 allowed up to 65 per cent plot coverage, real estate developers enforced a coverage of 80 per cent that was closer to the 'Old Law Tenement' (*ibid.*, p.21-22). After a number of architectural debates and competitions, the New York state legislature approved the Tenement House Act of 1901, known as the 'New Law'. The New Law provided speculative architectural variations which used up to 70 per cent of the land (based on a 40- or 50-by-100-foot lot) (*ibid.*, p.47-49).

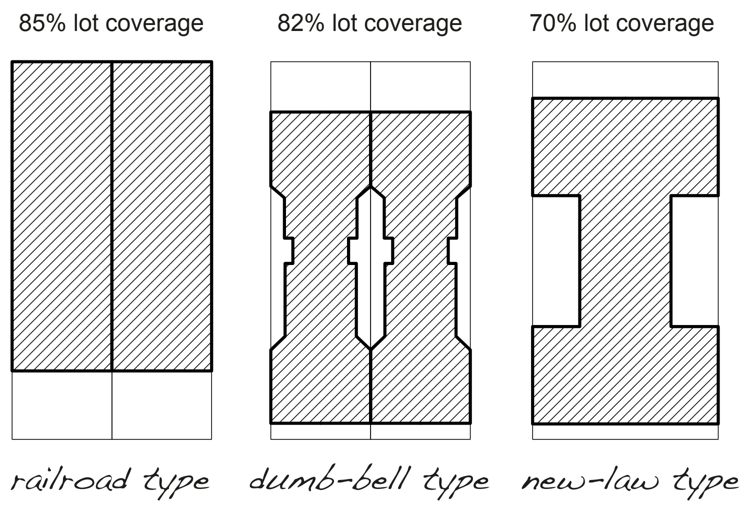


Figure 106. Footprints of old- (railroad and dumb-bell types) and new-law tenements.

Figure 107. Building façades of row house, old- and new- law tenements.

In the West Village the shifting character of the neighbourhood's residential sections began with the conversion of single-family houses into two or more apartments. Low rents attracted an influx of artists in the early twentieth century which led to a regeneration of the West Village row houses and old tenements in order to serve the aesthetic, and functional (studio/workspaces), purposes of urban bohemia (Dolkart, 2009, p.119-122). As commented in *American Architect* (1920), in a discussion regarding this evolving new neighbourhood profile, these transformations were driven by an effort to maintain the picturesque neighbourhood qualities of the old built environment. In the same discussion, it is claimed that this maintenance of old neighbourhood features was achieved through changes in the buildings' façades (p.146). These private neighbourhood revival efforts were soon supplemented by real estate practices. Dolkart (p.170) quotes from *Bruno's Weekly* issue of August 19, 1916:

> *'Every cellar and every garret – half-a-dozen years ago rented for very small prices to Italian families – brings high prices as a 'studio.' Old houses are being remodelled; they […] charge instead of six dollars a week, seventy-five dollars a month for a 'studio apartment'.'*

By the late 1920s, the real estate market was performing housing alterations aimed at young professionals, who could afford higher rents than artists. Row house conversions of the time are representative examples of the way real estate developers managed to use the *New Tenement Law* to their profit. Taking advantage of the area's artistic reputation, developers remodelled the row-house interiors without kitchen facilities and thus were able to have them designated as 'non-housekeeping' studio spaces for single young professionals (Dolkart, 2009, p.167). In reality, flats provided kitchen facilities masked as 'dressing rooms'. During these years the row house layout was tested and exploited to the extreme.

In this period domestic organisation shifted dramatically. Stairs and partitions were re-organised to form a new spatial layout of two apartments in the upper floors. Additionally, in many cases the basement or ground floor was appropriated for commercial use. In the case of row houses, domestic units increased to achieve higher densities. In contrast, tenements were rehabilitated by reducing densities from the building volume: rooms were joined together to form larger apartments, improving living conditions. It is interesting to note how the interior organisation of these building types made it easier for these alterations to occur without incurring significant changes to the built volume itself.

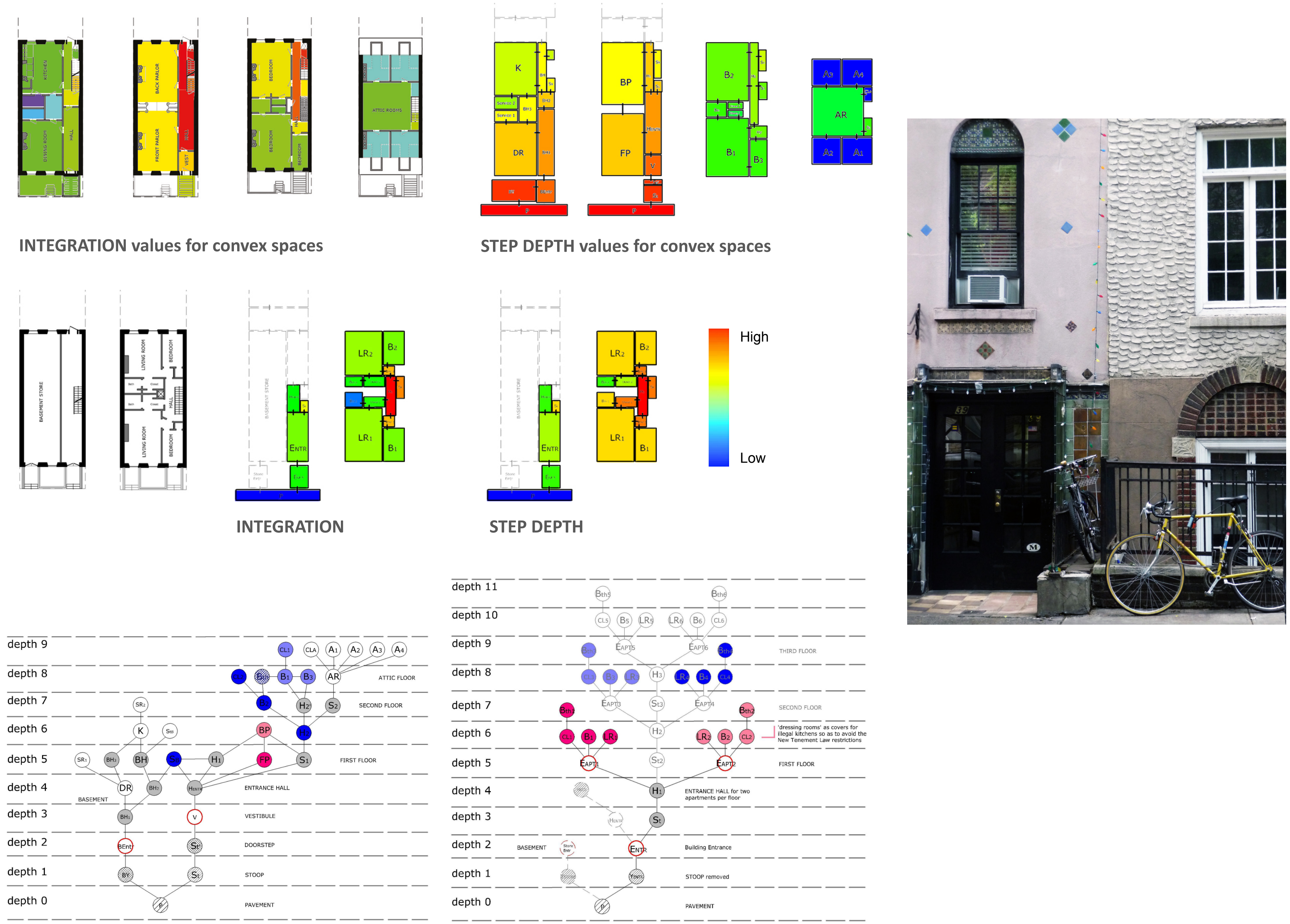


Figure 108. 39 Grove Street, the West Village – row house alterations.

(Floor plans based on Dolkart, 2009).

Figure 108 shows a representative example of a row house alteration from single- to multi-occupancy, with the addition of a store in the basement. 39 Grove Street is a Federal style row house (Dolkart, 2009, p.162-164). The building was improved in 1925 by architect Robert Gottlieb to serve the needs of its lessee. The justified graph representations of a typical single-family row house in relation to the converted 39 Grove Street configuration provide an understanding of the way higher densities were fitted within these small buildings. Apartments in the new configuration are the size of former rooms in the single-family unit. The architectural layout of new apartments – two for each floor – maximised the exploitation of the floorspace through a minimisation of transition spaces (circles in grey). Space syntax analysis of the layout representation as a 'convex map'[55] for each floor plan highlights the configurational properties which supported flexibility in conversions. The syntactical calculations illustrated in Figure 108 are for the measure of *integration*[56], showing the degree to which a space is directly connected to the spatial complex. Warm colours (red range) signify high integration values, namely more direct relations. The original building dimensions were designed so as to provide for a depth of two rooms and a width of one room plus the corridor with stairs, ensuring ventilation and lighting. As observed in the evolution of rows to tenements, Figure 108 shows how the symmetry of the plan has created equally integrated convex spaces facing both the front and the rear of the dwelling for each floor (notice the similar colouring of front and back rooms which indicates similar syntactical values for the measure of integration). This enabled a symmetrical distribution of inhabitants and room functions in new apartment units, which were mirrored along a central axis that divided the floor in two sides.

These interior/functional alterations also had an impact on the building-street interface, as can be seen in the example of 39 Grove Street. Apartments were accessed via a shared entrance and corridor. The removal of the stoop brought the residential entrance closer to street level, and an aesthetical demarcation of the ground floor (tile façade here, while stucco was used for the upper floors) imparted a functional distinction between commercial and residential use. These transformations

[55] A 'convex map' is a representation of the layout. Analysis of the map is performed in Depthmap software. A convex space is defined when dividing the spatial layout (floor plan) in the fewest and fattest polygons as possible, under the basic principle that all points within the convex polygon are mutually visible and accessible.
[56] The measure of integration shows how 'deep' (indirect relations between spaces) or 'shallow' (direct relations between spaces) is a spatial system considering calculations from all points in the system to all others (this is essentially the mean relative asymmetry; see Hillier and Hanson, 1984, p.15, 108-109).

worked together in creating a more direct building-street interface, closer to the pavement level. Dolkart comments on this treatment of the façade, describing it as *'one of the liveliest façades of the period'* (2009, p.163). According to the author, the building next door (no. 41) adds to this liveliness. The Italianate façade of 41 Grove Street is another architectural appropriation of the time, redesigned by Matthew W. Del Gaudio in 1929. Of interest here is the fact that architectural interventions at the building scale worked two ways: they allowed for purpose-fit functional adjustment, and at the same time they engendered a morphological diversity.

The built form of rows and tenements did not allow for building scale transformations only. Due to the underlying order in plot and façade organisation, architectural modifications could also be implemented at the block scale. Row houses were combined into apartment houses while retaining the façade arrangement of the historical shell. The flexibility of the underlying gridiron, extending from plot arrangement to floor plans (see Figure 109), enabled the complete functional conversion of historical rows. Gansevoort Market Historic District (designated in 2003) is an example of more recent gentrification processes where the historical built form has been subjected to block scale rehabilitation. Commerce, entertainment and offices now inhabit the historical rows in unified interior layouts which still remain faithful to the principles of the historical organisation of the façade.

The same underlying template that allowed for flexible spatial layouts also supported the adaptability of the building-street interface, depending on the type and scale of the transformation. As in the case of 39 Grove Street, floor plan alterations were imprinted on the building façade creating a constant rhythm of changing street interfaces. The following section investigates the physical properties of these building-street interfaces in terms of *density* and *functional and morphological diversity*. The aim is to understand the role of these physical qualities in producing probabilistic street interfaces in terms of encounter and co-presence patterns.

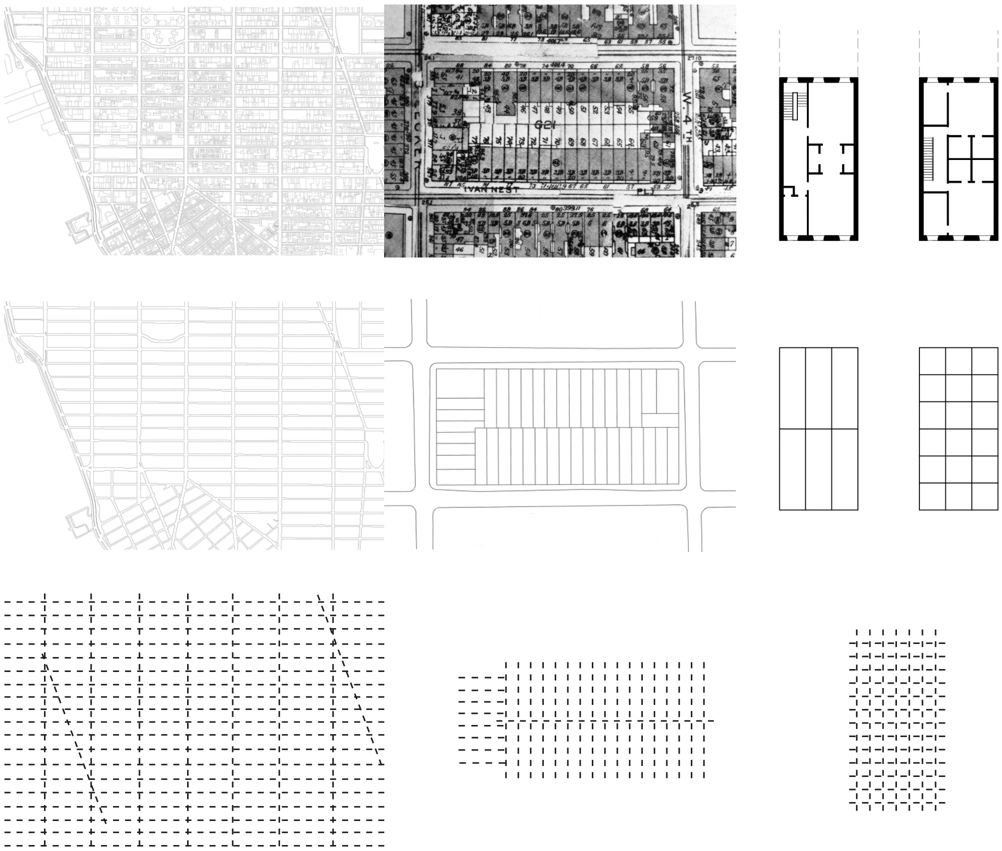


Figure 109. Manhattan – the underlying gridiron. Cross-scales organisational consistencies; from the urban grid to the building interior.

6.4.3. Historical building types and their building-street interface

Figure 110 illustrates the continuity of the historical built form in the West Village. The map records the presence of row houses and tenement buildings for c.2013. As expected, the majority of historical buildings lie within the boundaries of the Historic District and its extensions. Buildings are coloured based on age, and consequently, based on morphology. The colour range (light-oldest, dark-newest) represents three main building types: the shell of a single-family row house; the railroad and dumb-bell types of old-law tenement; and finally, the new-law tenements (Plunz, 1990, p. 49; see also Figure 106). Over time, single-family row houses were converted to serve multiple occupancy with commercial uses on the ground floor. In some cases these houses became live-work places (for instance, an artist's studio and residence). The study here considers the building shell, since the primary focus is the organisation of the façade and subsequent building-street interface. The historical building typologies discussed reflect differences in façade organisation. As seen in the case of Grove

Figure 110. The West Village, Manhattan – historical building types. (c.2013)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

Street, the façade treatment is tied directly to the organisation of the floor plan. The next paragraphs explain how, in turn, the façade organisation relates to the building-street interface and the potential alterations these building types presented over time at the level of the ground floor.

The early row house façade presents a trilateral organisation, where the building entrance is located at one side and accessed via the *stoop* (a stepped entrance or porch). In these small buildings, only one extra entrance, either domestic or non-domestic, is seen to be added over time. The railroad and dumb-bell types (old-law) are larger in scale (both for façade width and height), with four columns of windows facing the street and the main building entrance located in the middle of the façade. In these cases, commercial spaces usually open up the ground floor towards the street domain, with a store at either side of the central residential entrance. In new-law tenements the building facade is wider that the previous types and the subdivision of the ground floor in more units is less frequent; a single main domestic entrance is usually found the middle of the façade width, creating thus a more 'solid' ground floor.

Indeed, it is observed that narrow façades – whether single or aggregated – turn out to have the greatest potential for creating a dense interface. In order to compare the frequency of doorways across the three historical building types in the West Village, we can examine the *door encounter rate*: as explained in the methodology, this refers to the relation of (1) the total number of building entrances for each type with (2) the total façade length in each case (Table 39). Results show that when walking in a streetscape of row houses, users would expect to find a building entrance every 4.5 meters. A similar street interface is created by old-law tenements, with a door found in every 4.8 meters due to the slight increase in plot size. The larger scale new-law tenements would present a sparser interface, with doorways lined up approximately every 6 meters.

Additionally, we can consider all building typologies in the West Village, comparing the features of historical to non-historical units in terms of the *interface density measures* for street segment sides. Figures 111 and 112 show the percentages for each building typology situated on a street side with high to low interface density (block front / segment length, historical threshold frequency / current threshold frequency). New-law tenements are most likely to be located on greatly built up sides, but have a lower presence than row houses and old-law tenements in those street sides with a high threshold frequency.

TABLE 39 Historical building types	**Buildings**	**Doors**	**Tot Façade Length (m)**	**Door encounter rate (m)**
Row house	1324	2477	9523	4.5
Old-law tenement	244	523	2139	4.8
New-law tenement	101	326	1463	5.9

Table 39. The West Village, Manhattan – historical building types; street interface. (c.2013)

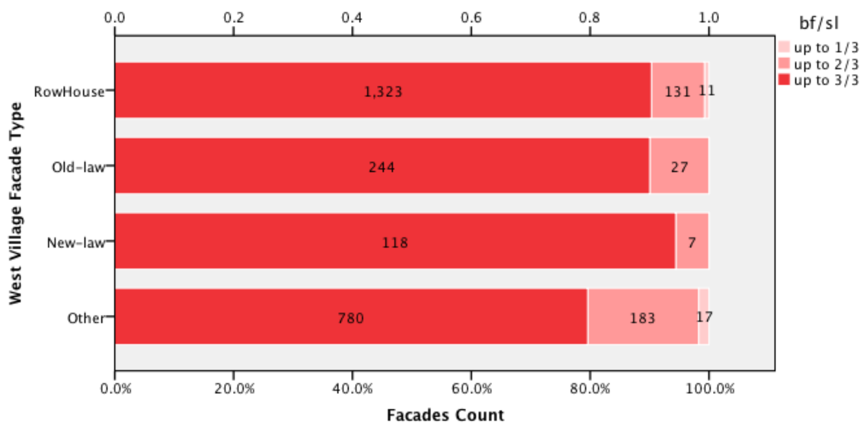


Figure 111. The West Village – historical building types; *block front length / segment length.*

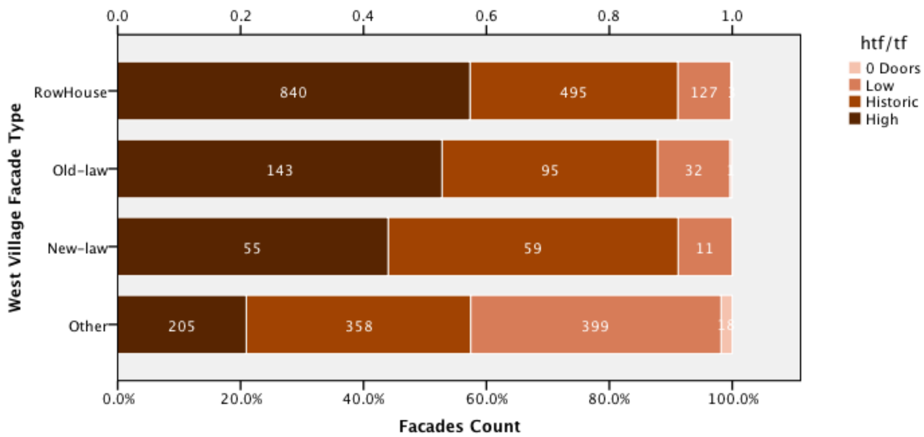


Figure 112. The West Village – historical building types; *historical / current threshold frequency.*

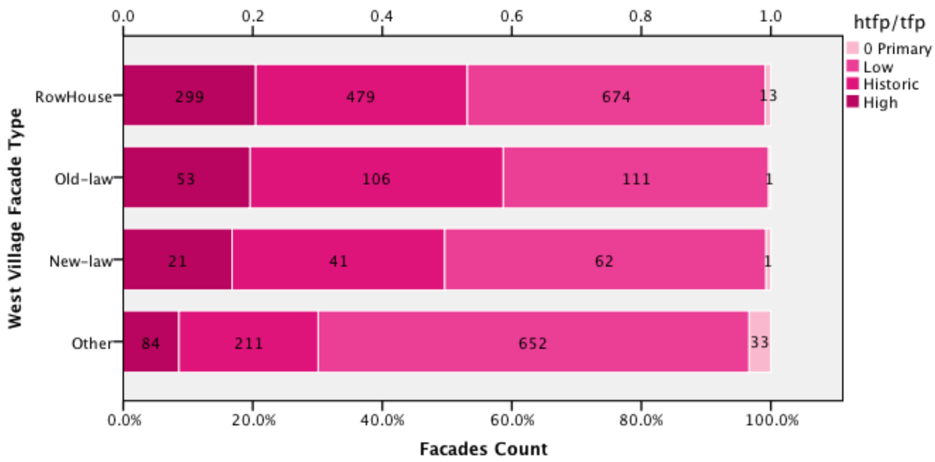


Figure 113. The West Village – historical building types; *historical / current threshold frequency* for direct entrances.

Tables 40 and 41 provide a detailed record of threshold uses and transition type (direct or indirect) for each building typology. In all cases, a mix of building uses is observed. Considering that the old-law tenements are (1) denser in interfaces than the new-law tenements, and (2) have a greater mixing of uses than row houses (due to their larger size), it could be said that the old-law tenements present the most urban interface of the three. As confirmation of tenements as the most urban building type, these buildings are found to have the highest percentages of non-domestic thresholds. Old-law tenements also display a higher presence of street segment sides with a high and historical threshold frequency of direct entrances (Figure 113). The smaller row houses are primarily residential and have the highest percentage of stoops (28.3%) and indirect building-street connections (29.8%) across the study area. Overall in the West Village, row houses and old-law tenements – those with the narrowest façades – are found to have exploited the ground floor façade through alterations to the greatest extent over time.

TABLE 40 Use	Buildings	Doors	Domestic	Commercial	Community	Other	Vacant
Row house	1324	2477	1763 71.2%	596 24.1%	19 0.8%	72 2.9%	27 1.1%
Old-law tenement	244	523	325 62.1%	184 35.2%	0 0.0%	12 2.3%	2 0.4%
New-law tenement	101	326	173 53.1%	142 43.5%	1 0.3%	10 3.1%	0 0.0%

Table 40. The West Village, Manhattan – historical building types; threshold use. (c.2011)

TABLE 41 Type	Buildings	Doors	Direct	Indirect	Stoop	Blank
Row house	1324	2477	1738 70.2%	739 29.8%	702 28.3%	87 3.5%
Old-law tenement	244	523	435 86.6%	88 16.8%	113 21.6%	10 1.9%
New-law tenement	101	326	255 78.2%	71 21.8%	56 17.2%	21 6.4%

Table 41. The West Village, Manhattan – historical building types; threshold type. (c.2011)

Throughout the process of urbanisation over the last century and a half, the interfaces of these buildings had to adjust their physical properties to respond to shifting densities and changing uses. As shown previously via the temporal study of street configuration, space has distributed varying potentials across the West Village: the buildings have been adapted spatially, morphologically and in their interface, to accommodate different ways of living and/or different land uses, all in the context of a changing social, economic and regulatory background. The variety of uses – and in many cases their mixing at the building scale – which inhabited over time the historical rows and tenements can be seen in Figure 114, where the maps record historical land uses for row houses and old-law tenements. It is observed that these narrow-fronted building types – with the flexible floor plan organisation previously mentioned – have been used for almost every possible building function: residence, commerce, office, community facilities and storage (warehousing). Building façades responded to land uses, changing the public nature of their street interfaces by altering the way entrances met the street. This is shown in Figure 115, where row houses and old-law tenements are coloured based on their current – direct or indirect – relationship with the street domain. Here, again, the varying building-street relations that have developed over time can be observed.

It is evident that these shifts in thresholds have occurred through piecemeal transformations which multiplied the *density* and *functional* and *morphological diversity* of building-street connections – firstly at the building scale and subsequently at the block scale. The following paragraphs discuss in greater detail how the historical façades created a dense streetscape of differing functional and morphological combinations.

Figure 114. The West Village, Manhattan – building use record for row houses and old-law tenements. (c.1921, 1955, 2011)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

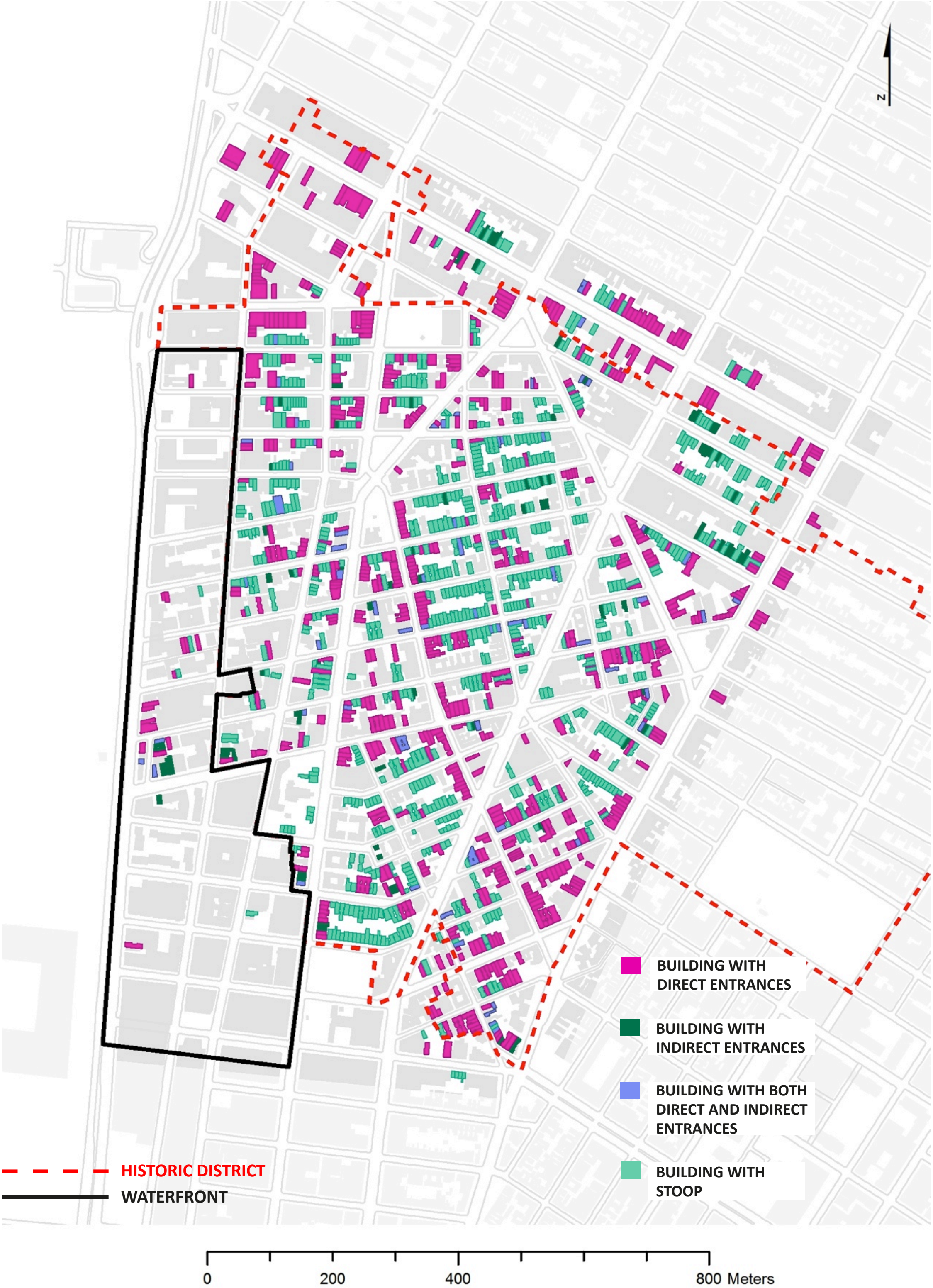


Figure 115. The West Village, Manhattan – row houses and old-law tenements; type of transition. (c.2011)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

Building-scale diversity: use and morphology

In the examples of building transformations in the West Village (Figure 116), it can be seen that row house and tenement fronts have followed a consistent pattern of façade alterations. In most cases, this pattern is organised in such a way that the historical morphological rhythm of the block front is not disrupted; it only becomes denser. The openness of the façade to the public street domain depends on the social nature of building functions. For instance, when a commercial use is introduced into the building, the façade is opened up to the street, with a large horizontal casement window and a direct entrance. In this way, the shop interior is on display, creating a more public interface that allows interaction between the retailer and the pedestrian. Pavement use is extended visually (and accessibly) to the interior and vice versa. Moreover, the impact on façades is also dependant on location. For well-connected locations in the grid, building units are found to squeeze as many as three door entrances within a single façade. Entrance placement here complies with the organisation of the façade (trilateral for rows, quadripartite for tenements): two ground floor commercial entrances and one domestic, which leads to upper floors. In the case of less busy street sections, when stores are embedded in the building layout, they tend to form part of the basement (as in the example of 39 Grove Street, described earlier). In this case, the stoop is not necessarily removed. The store is accessed through a descending staircase, while the elevated stoop entrance leads to the upper residential storeys. On the other hand, conversions of single-family row houses into multiple-dwellings usually involve the removal of the stoop; besides this change, internal shifts in the floor plan are not obvious in the building frontage due to the flexible underlying synthetic principles of the unit (both in plan and façade organisation).

Figure 117 illustrates the type of transition and frequency of entrances per building unit. The type of transition corresponds to the location of the building in the grid. The figure shows that direct entrances face Seventh Avenue, a route with a high potential for pedestrian flows (high syntactical values) and city-wide connections. Thresholds here appear denser than recorded in those segments away from the main street. These latter, quieter, street sections are aligned with historical ascending and descending stoops which produce a more local character. Bobic (2004, p.105) comments that the configuration of the stoop creates an *'associated'* interface between the private and public domains. The stoop configuration manages to maintain a *'subordinate status'* for the two intersecting – and potentially interacting –

Figure 116. The West Village, Manhattan – building façade and threshold alterations. (c.2011)

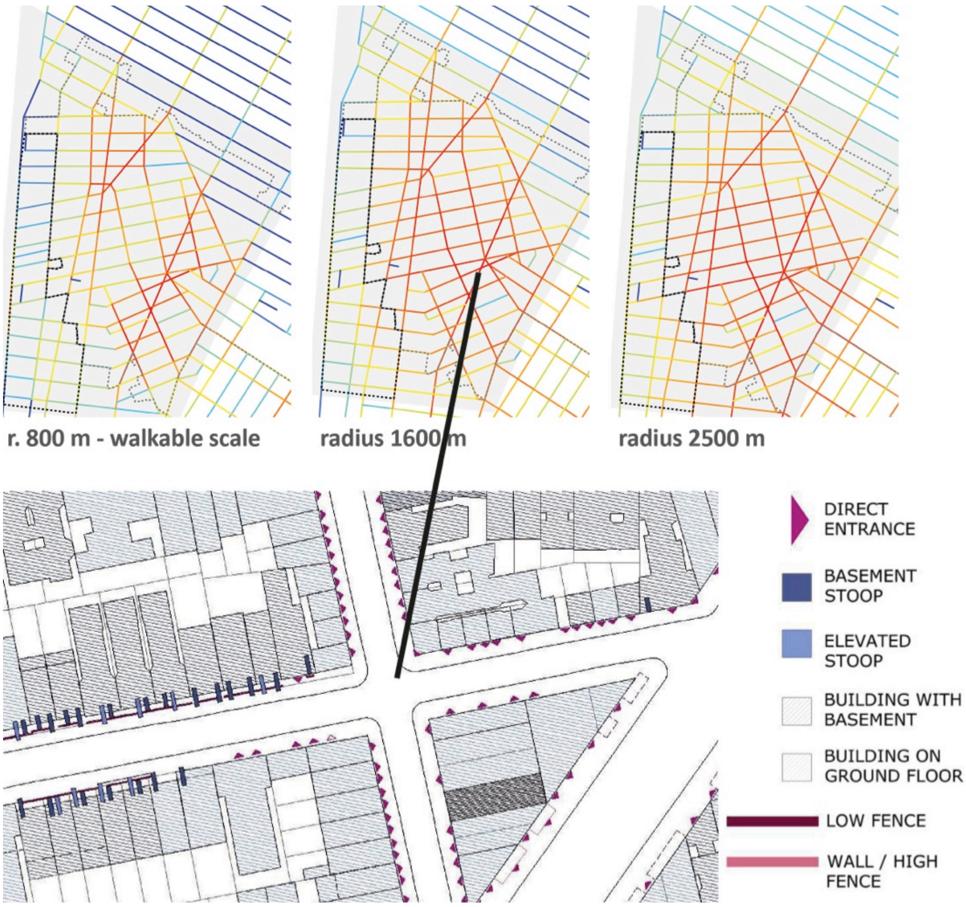


Figure 117. The West Village, Manhattan – morphological diversity of thresholds. (c.2011)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

domains of building interior and street. Stoops highlight the rhythmical variability in type and boundary configuration in many ways: placement (ascending/descending), height and number of steps, width, ornamentation in ironwork, as well as the material, opacity, and visibility of door entrance itself. All these architectural features create a vivid micromorphology of varying interior-exterior relations. In the Historic District block fronts, public and private domains are interrelated with tight proximity, accessibility and visual contact.

Overall, in all cases these new interior-exterior relations were architectural appropriations 'fitted to the case', giving an essence of informality and openness to the emerging neighbourhood's socio-spatial morphological rules. On the whole, the pre-existing organisational logic in the historical built form aggregated these individual transformations within a unified and co-operative spatial system, creating rich and diverse street views.

The mingling of different architectural styles

However, the morphological diversity seen at the building scale in the West Village streets is not just a product of piecemeal transformations. The area presents a remarkable richness in historical building stock from different time-periods. Each chronological period imposes its own variations in architectural style and building-street interaction. In his book *Bricks & Brownstone* Lockwood (1972) provides a detailed description of each row house style found in New York City, while the first *Historic District Designation Report* summarises the styles seen in the specific context of the West Village. The following paragraphs describe the most popular styles of row houses in the neighbourhood, with a focus on the nature of the public-private transition of each. The discussion aims firstly to acknowledge that the supposedly generic 'row house' typology actually had a rich *variety in micromorphology*; and secondly, to emphasise that each style is bound up with the way in which building-street interfaces were formed and adapted.

The earliest urban houses in the area, dating from 1790-1835[57], belong to the Federal style (Figure 118). These row houses were two-storeys high, with a basement and an

[57] As clarified in the 'Architectural Importance' section of the Historic District Designation Report, the dates mentioned are only approximations of the each style's duration in Greenwich Village.

attic with dormer windows. The use of different construction materials differentiated the upper floors (Flemish brickwork) from the basement (rusticated stone). Low stoops served as semi-public building thresholds. In some cases, the area next to the stoop was bounded with ironwork forming a small semi-private yard with few descending steps leading to the basement. The commercial-residential hybrid (Davis, 2012) made an appearance in these early rows. When located at the block corner, this building type presented direct entrances on both sides facing the street (with the commercial on the narrow side, and residential on the long), with the shop at the ground level.

The Greek Revival row house of the following period (1828-1848) is one storey taller than the Federal and less modest in design (Figure 119): the style is characterised by its classical references in ornamentation. During this period the standardisation of craftsmanship was established [58] with detailed builders' guides and instruction handbooks. As a result, the rows of Greek Revival houses compose a uniform block front with building units distinguished by the rhythmical presence of stoop entrances. This façade uniformity arose from the intention of the Greek Revival style to symbolise independence following the formation of the New Nation. Rows of houses in this case resemble the terraces of London[59]. The stylistic freedom and 'informality' within the row of the Federal years is replaced with more formal architectural details. The style represents the city's increasing prosperity and its well-to-do inhabitants. As the façade became more formal, so did the building-street relation: stoops increase in height reflecting the inhabitants' prosperity and 'social status'. Many of these block fronts, especially those found in the interstices of the West Village grid, have a strong domestic character. This fact, in combination with the morphological unity of the Greek Revival rows, increases the chances for functional continuity over time, rather than change (as discussed earlier in Chapter 3).

The most grandiose scale street interface seen in row houses came with the Italianate style (1850-1865). This is the famous New York 'Brownstone': an Italianate house with the façade covered in brownstone (Figure 120). The four-storey high façade is based on the typical trilateral organisation, with an imposing double-door entrance on

[58] Builders' guides existed since the seventeenth and eighteenth centuries and were based on popular English pattern books. The first American authored handbook was published in 1797 (Lockwood, 1972, p.30).

[59] Still, as discussed in Chapter 3, unity in the London terrace is greater than in the New York row housing fronts.

the one side. The public-private transition happens via a stoop which is not only significantly higher than seen in the previous periods, but wider as well. In some cases, the stoop rises almost a floor higher above the street level and underneath it lies the entrance to a basement accessed through the areaway. A variation of this building-street interface is seen in the 'English basement', in which case the interior is accessed via low stoops resembling an English terrace. As stated in the Historic District Designation Report, the closer building-street interface of the Anglo-Italianate style *'was extremely elegant and urbane'*.

Figure 118. The West Village, Manhattan – Federal row houses. (c.2011)

Figure 119. The West Village, Manhattan – Greek Revival row houses. (c.2011)

On the right, the stoop and entrance ornamentation.

Figure 120. The West Village, Manhattan – New York ‘Brownstones’. (c.2011)

On the right, the areaway and basement entrance.

Figure 121. The West Village, Manhattan – diverse streetscape.

Figure 122. The West Village, Manhattan – west waterfront.

© Google Maps, 2014.

Other styles include the French Second Empire (1860-1875) and its variation the Neo-Greek style (1865-1880), and the classicism of the Eclectic Period (1893-1915). In general, it can be said that the Federal was the most flexible of all styles; the building unit maintained a certain stylistic autonomy within the row and the low stoop could be easily removed to achieve a more direct, and more urban, relationship with the street. Towards the turn of twentieth century the more urban types of commercial-residential units and apartments were spreading. As construction materials and methods became more advanced, the commercial part of the façade was increasingly opened up towards the street with larger windows. At the same time urban apartment buildings such as tenements established the use of entrance porticos close to the street level, accessed via short stoops.

Collectively the buildings from different time periods interlace to produce varying dynamics in many levels: physical, social and economic (Jacobs, 1961, p.187-199; Figure 121). The study here emphasised the morphological diversity generated by building-street connections: the interfaces which organise social encounters. Density of interfaces and mixing in uses and in morphology (at the building-scale and in consequence at the block scale) constitute physical properties which create higher potential for respectively dense and varying social encounters; namely, physical properties that enhance probabilistic sidewalk micromorphology.

Considering that the effects of time generate transformations across building units – which imprint on building morphology – it is understood that the composed *micromorphology* becomes increasingly rich over time. On the other hand, the fact that built form is organised in such a systematic way – with the impact of the gridiron passing from plots, to floor plans, to façades – creates a consistent rhythm and symmetry in the composition of the street façade. In this way, new building additions become integrated over time and add to the West Village narrative. It can be said that the West Village is a place that triggers physical diversity and at the same time reconciles conflict by remaining faithful to the organisational principles of the built form; a case of 'organised complexity', of *embedded diversity*.

6.5. The West Village: embedded diversity

It is of interest here to cite the guidelines for new development within the Historic District from the 1969 Historic Designation Report:

> *'The architect should take into account his surroundings, including the adjoining buildings and those across the street and along the entire block front. The new building should relate well to its neighbors in terms of materials that are used, the architectural proportions, the size and shape of the windows and the details on the front of the building, such as the exterior lighting and other features. Essentially the most successful new design in an Historic District will be the simplest. The architects should avoid the use of too many different materials and the creation of bizarre effects.'*

The report emphasises the role of the *part* in relation to the *whole.* Here, the primary city component is the building. Consequently, transformations are piecemeal and applied at the building-scale, retaining references to the proximate urban whole. This allows for flexible, purpose-designed solutions that acknowledge specific socio-spatial contexts and can range chronologically rather than occurring all at once. The opposite is seen in the block-scale replacements that redeveloped the west waterfront (Figure 122). Looking at the rigid block fronts of these complexes, Julienne Hanson's words are pertinent: *'Indeed, the whole story is one of a ruptured interface between dwelling and street'* (2000, p.113). Here, the building-street interface lacks all the aforementioned micro morphological qualities that contribute to the virtual community; it lacks density, as well as functional and morphological diversity. To Jacobs (1961, p.198), such a place '*shows a strange inability to update itself, enliven itself, repair itself, or to be sought after, out of choice, by a new generation. It is dead.'*

In the West Village, historical built form is not an architectural fossil preserved intact. Instead '*the feeling of history that permeates its streets'* – quoted in the beginning of this chapter from the arguments in the Historic Designation Report – derives from the fact that shifting densities, populations, uses, and architectural styles, have all left their mark on the streetscape. The area's urban history can be read in the built form properties (morphology and use) of the urban streetscape.

The flexibility of historical row houses at the building scale, both in layout and façade, along with regular plot organisation allowed for 'fitted-to-the-case' piecemeal transformations. These spatial and physical potentials make the West Village a living example of *'probabilistic space'* where heterogeneity is enhanced (Hanson and Hillier, 1987), sustained and even nourished further over time, resulting in lively streets. Analysis of the neighbourhood's current socio-spatial profile in relation to temporal analysis of urban transformations in the area revealed the spatial and physical properties that allowed for emergent diversity of the street interface to occur and accumulate over time. Arising from all those insights retrieved from the recorded vibrant sidewalk micromorphology of the West Village, we can suggest potential learning with regards to those morphological properties that contribute to the probabilistic micromorphology of street interfaces:

Elements which can be defined by design:

- *The plot size*: narrow plots mean narrow building façades which increase the potential for a high threshold frequency across the block frontage.
- *The block size*: short blocks, and respectively short segments, generate higher potentials for accessibility and permeability, attracting the pedestrian overflow.
- *The parts-whole consideration*: organisational consistencies across the various city elements – the buildings, the block, the street.

Elements which can be supported, enhanced and/or generated by design:

- *Functional diversity*: the mixing of building uses within the block frontage length.
- *Morphological diversity*: buildings with varying architectural styles and consequently varying treatment of the private-public transition.

This second analytical chapter closes with the acknowledgement that conservation and historical designation policies are not austere frameworks which restrain architectural creativity, but rather that they act as incubators of the integrated past and futures of urban materiality.

The next chapter brings together the street network and built form properties of both case studies in a comparative overview in order to form some general observations with regards to the micromorphology of the street interface.

7

Chapter seven - Interfaces and streetscapes

The analysis has so far presented a narrative of the historical patterns of urban change in Islington and the West Village, concentrating on relating the density, and the functional and morphological diversity of the street interface to (a) the street network properties; (b) the built form properties; and (c) the historical processes of urbanisation. Observations from the two case studies have confirmed a number of significant points:

- the role of the street network in the distribution of land uses;
- the impact of building function on the morphology and immediacy of the interior-exterior transition; and
- the impact of building morphology – from the building unit to the block scale – on probabilistic interior-exterior encounters, in terms *both* of a dense and diverse micromorphology of the street interface *and* of potentials for adaptability in change.

The focus of this chapter is to compare the two case studies side by side in order to unravel the differences, and consistencies, in the way the row housing streetscape has developed in each case. The particular questions addressed here refer to the following:

- the extent to which consistencies across the two urban realms have informed the generic nature of the building-street relation in row housing schemes;
- whether the contrasting differences between the two urban grids have influenced aspects of the building type's manner of change or continuity over time, particularly with regards to the relationship of the building with the street; and
- the impact of conservation and Historic District designation policies on the longevity of the building type.

This is an essential step to take before moving into the concluding discussion which will examine this study's contribution to knowledge, its limitations, and its potential to trigger future research objectives. In what follows, the first section summarises, clarifies and brings together in a comparative presentation the results from the two case studies, in order to reach some conclusions regarding the historical *interplay* of street configuration, building morphology and building function in shaping varying street profiles. Next, the discussion is organised based on the narrative of the previous analytical chapters: an exploration of the role of the street network in shaping the street interface, an overview of the contribution of built form properties in configuring a dense street interface, and finally, a summary of the role of conservation policies on the survival of historical buildings in both case study areas.

7.1. The two case studies: an overview

This section briefly outlines a comparative overview of streetscape properties in the two case studies. As discussed in the introduction to the urban setting of the two metropolises (in Chapter 3), London and Manhattan – and consequently, Islington and the West Village – present different urban profiles. The spatial structure (street network), the physical properties (built form) and the supported socio-economic functions have jointly shaped the unique streetscape of each city. In contrast to Manhattan's exceptional vertical growth, in the West Village itself urbanisation has conformed to a horizontal scale analogous to London's street landscape. This fact made the two case studies comparable and provided a chance to investigate the nature of historical built form transformations under differing urban circumstances and challenges.

The study in Islington focused on the blocks around Upper Street – the area's historical thoroughfare. While covering less than half a square kilometre more than the West Village area, Islington contains twice the number of segments. This reveals the fragmented and irregular character of the London city grid in comparison to Manhattan's orthogonal street pattern. The high presence of very short segments in Islington – almost three times more than seen in the West Village – is a further manifestation of this irregular street morphology (Figure 123). The mean segment length for the West Village exceeds that of Islington, with indeed a much higher proportion of segments at the upper quintiles of length. Note, for example, the very long straight block sides at the north east side of the West Village; these follow the orthogonal pattern of the neighbouring Village blocks defined by the Commissioners' plan.

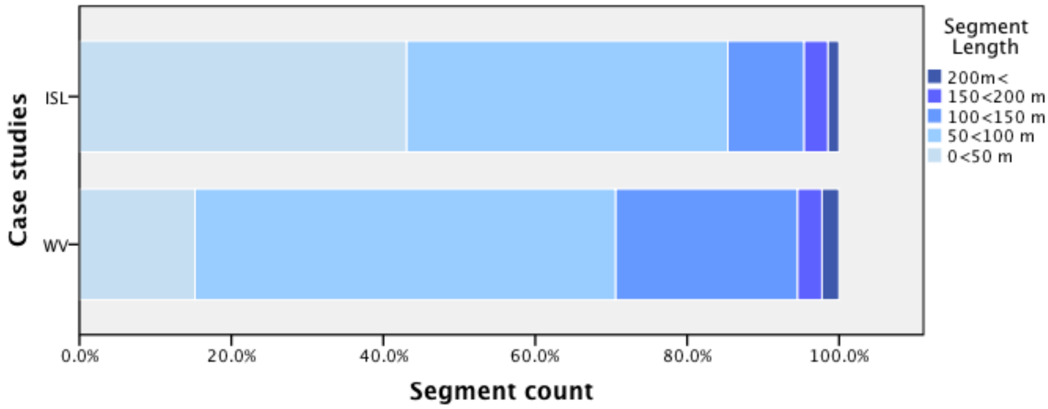


Figure 123. Case studies – segment count according to segment length.

An analysis of the number of building thresholds (i.e., 'Doors' in Table 41 in relation to the number of façades recorded in the areas indicates differences in the way the historical building-street interface has developed over time in each case. Since both case study areas were originally built up with single-family middle class dwellings, it is natural to assume that the original ratio of doorways to façades would be one doorway per building façade for both areas. However, the present doors/façades ratio for Islington is 1.4 doors per façade, while for the West Village this increases to 1.9. Table 42 shows that the West Village presents a greater balance between domestic and non-domestic uses; thresholds related to non domestic uses are here twice the number found in Islington. Still, in both areas almost one third of building thresholds have an indirect relationship between the street and the interior; these secondary thresholds are constructed by the specific architecture of the type's building-street relation – stoops and areaways dressed with cast ironworks, – and contribute to the diverse micromorphology of the pavement configuration. Overall, these results indicate a different urban profile for the two areas. The following analysis sheds further light on this suggestion, with the application of more detailed measures the building-street interface.

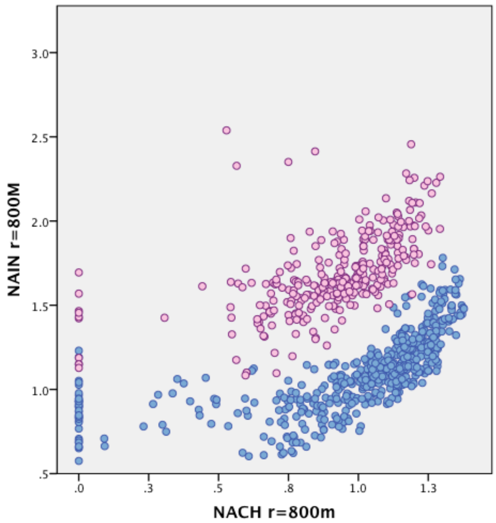
TABLE 42 Case studies	Area km^2	Segments	Total Segment Length (km)	Mean Segment Length (m)	Façades	Doors
Islington	1.8	635	37.7	59.4	5462	7391
The West Village	1.4	341	28.6	84.0	2847	5504

Table 42. Case studies – street interface.

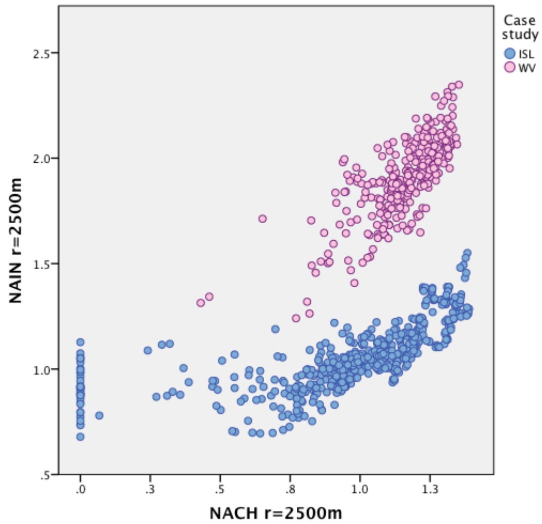
TABLE 43 Case studies	Façades	Doors	Domestic	Non Domestic	Direct	Blank
Islington	5462	7391	5766 78.0%	1625 22.0%	4980 67.4%	454 6.1%
The West Village	2847	5504	2900 52.7%	2604 47.3%	4362 79.2%	557 10.1%

Table 43. Case studies – building thresholds.

Looking at the properties of the street network, it is anticipated that the West Village will have a more urban profile than Islington in terms of its spatial accessibility. The *normalised measures* allow for space syntax (syntactical) values to be compared across different spatial systems. Figure 124 shows a plot of syntactical values for the two case studies, presenting the measures of *normalised integration* (NAIN) and *choice* (NACH) at the local scale (radius 800m) and the wider surroundings (radius 2.5km) for the same modelled area. Not only are the correlations between choice and integration at both scales higher for the West Village than Islington respectively it can be observed that the West Village streets overall have higher values of integration overall, particularly at larger scales (meaning a greater potential to serve as destinations for pedestrian movement). This finding supports Hillier's contention that there is a structural difference between the London and the Manhattan grids, since higher integration indicates a background network that is better connected to the foreground city structure (Hillier et al. 2013).



Normalised choice (x) and integration (y) for radius 800 meters.

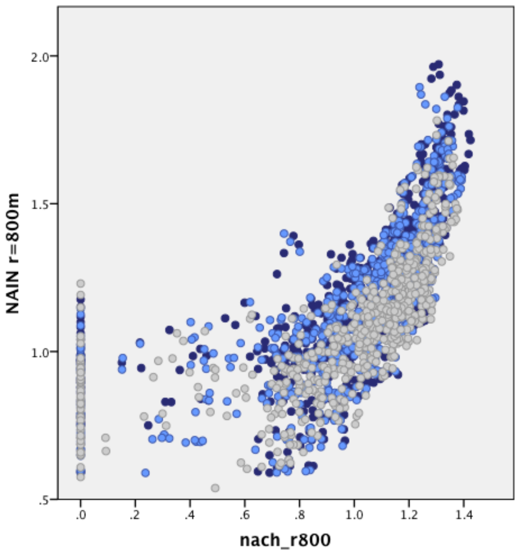


Normalised choice (x) and integration (y) for radius 2500 meters.

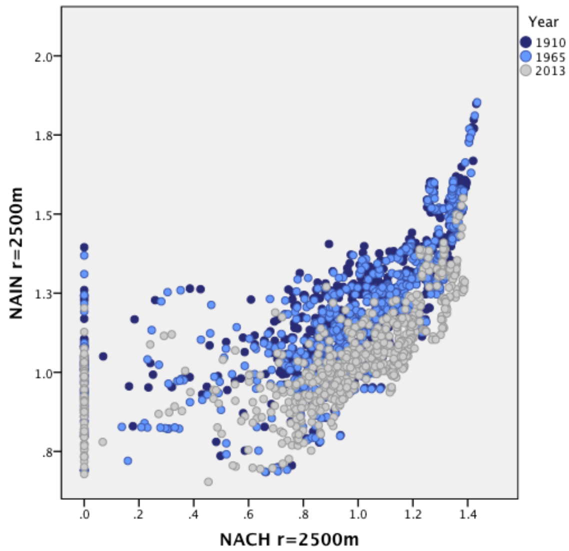
Figure 124. Case studies – the segment values for the *normalised measures of choice and integration*.

Showing Islington in blue colour and the West Village in pink.

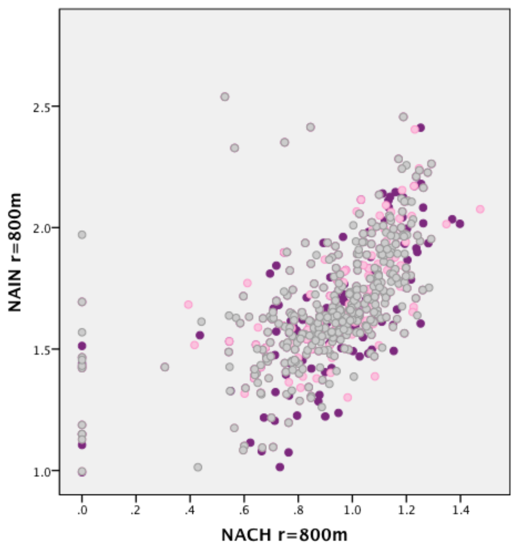
This proposition is explored further by taking the same plots as in Figure 124, and comparing them with the values for space syntax models created for two historical periods (Figure 125: c.1910-1965 and c.1965-2013 for Islington – upper pair of graphs; c.1921-1955 and c.1955-2011 for the West Village – lower pair of graphs). The results show that on the one hand the West Village maintains a similar configurational profile in the course of time. This can be explained by the fact that there is little change occurring across the Manhattan grid overall, due to the city's geographical constraints, which necessitated a primarily vertical expansion. On the other hand, London's horizontal expansion, favouring densification rather than increasingly tall buildings, creates greater opportunities for configurational shifts to manifest in the background grid structure (Vaughan et al., 2013). Moreover, it can be seen how in 2013 values in the area are in fact, lower than in the earlier periods.



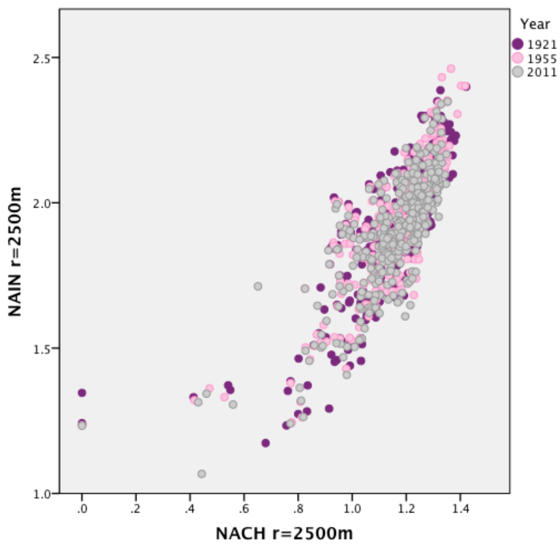
Normalised choice (x) and integration (y) for radius 800 meters – Islington.



Normalised choice (x) and integration (y) for radius 2500 meters – Islington.



Normalised choice (x) and integration (y) for radius 800 meters – the West Village.



Normalised choice (x) and integration (y) for radius 2500 meters – the West Village.

Figure 125. Case studies – the segment values for the *normalised measures of choice and integration* over time; for early, mid-twentieth century and present years.
Showing Islington in blue colour (top) and the West Village in pink (below).

This brief presentation of the profiles of the Islington and the West Village areas suggests that the street configuration has developed differently in each case. As mentioned in the theoretical review, the work of Kayvan Karimi (1998; 1999; 2000) on historical city centres in England and Iran has previously suggested the effect of grid transformation processes on continuity and change in the historical building fabric (see earlier in Section 2.2.1). Taking into account the morphological kinship of terraced and row houses on the one hand and the contrasting city grid configurations on the other, the role of the street network in generating different evolutionary pathways for continuity and change in building form is indicated. Section 7.3 aims to shed further light on the potential correspondence between street configuration and built form properties.

7.2. Street network and street interfaces

In both case studies, explorations began by looking at the spatial properties of the street network. It has been seen how the grid configuration influences land use allocation and the distribution of domestic and non-domestic building thresholds. It was also shown that streets which are better connected to their surroundings are more likely to produce a street interface denser in probabilistic interior-exterior encounters. At this final stage, our analysis examines the relationship between street configuration (and respectively, movement potential) and street interface density.

Both cases typically have buildings which historically had a width of 6 meters on average, with a single doorway and a primarily domestic use. Here the analysis takes this notional starting point and discusses how the historical building-street interface was transformed over time from the point of view of: (a) building modification (calculated by block width); (b) subdivision (calculated by number of doorways); and (c) functional diversity. Figures 126-128 summarise the properties of street segment interfaces in each case study area, considering the block frontage and doorway frequency for each street side (i.e., the array of entrances) separately. The figure shows: (a) the *block front / segment length ratio*; (b) the *historical threshold frequency / current threshold frequency* ratio; (c) the same ratio, but this time calculated considering only *direct building-street connections*; and finally, (d) the street segments' *diversity in uses* associated with thresholds. To remind the reader, the *block front / segment length* ratio (*bf/sl*) describes how built up a segment side is. When this ratio equals zero, this means that there is no presence of buildings on that street side. The *historical threshold frequency / current threshold frequency* ratio (*htf/tf*) measures the density of the street side's interface in terms of building thresholds in comparison to a typical historical street side. A zero ratio in this case means that there are no doorways on that street side (i.e., either no buildings, or blank walls). The *historical threshold frequency / current threshold frequency* ratio of *primary thresholds* (*htfp/tpf*) calculates how dense a street side is in direct interior-exterior accessibility relations.

The graph in Figure 126 summarises building densification for the street segment sides in both areas (*bf/sl* ratio). The graph classifies street segment sides in four general groups: those almost entirely built up (between two thirds and the entirety of the segment length is covered alongside); those built up more or less half way through (up to two thirds); those mostly left uncovered (up to one third); and finally street sides with no presence of buildings. This last group includes those streets adjacent to a park, square, or junction. There is a higher occurrence of street sides with no buildings in Islington. This is explained by the fact that junctions are found more frequently within an irregular city grid like that of London (where a complex geometry might result in a segment having no buildings bounding it) than the orthogonal grid seen in Manhattan. In addition, Islington contains more squares and green spaces than the West Village. In general, the Village is significantly more built up, with street sides with a high building densification composing almost 15% more of the streetscape than in Islington.

The next graph (Figure 127) indicates whether block fronts have an increase in threshold density over time, if they have remained more or less the same, or if they now present a sparser building-street interface. From the percentages it can be seen that both areas present a similar increase in threshold frequency ('high' groups, coloured in dark brown). However, the West Village has retained the encounter frequencies of the historical streetscape to a slightly greater extent ('historical' in graph; brown colour). Moreover, it presents many fewer street segment sides with no doors (14.6%). Notably, in Islington the proportion of streets with no doors (22.7%) exceeds the proportion of street sides with no buildings (14.9%) (see Figure 126), meaning that there exist in Islington street sides where there is no access from the street domain to the building interior (segments sides with no buildings in the West Village are almost same as the ones with no doorways, at 11.6% and with a difference of 3%). Overall, around 20% of segments sides had an increase in doorway density from the historical starting point, raising the question of whether they were subdivided for domestic purposes, or for commercial purposes (as is explored in Figure 129).

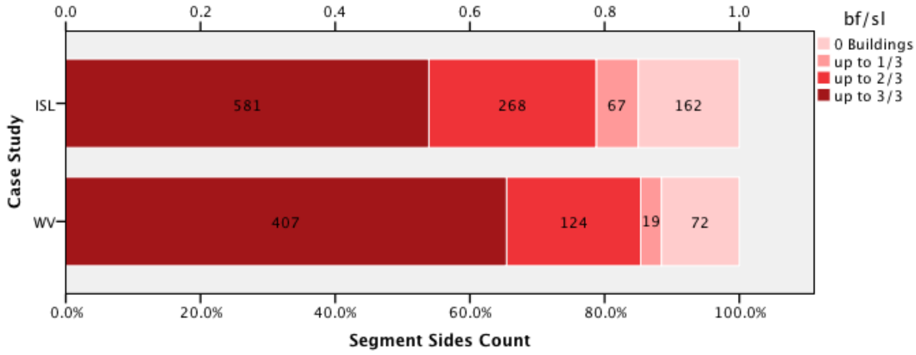


Figure 126. Case studies – *block front length / segment length* for street sides.

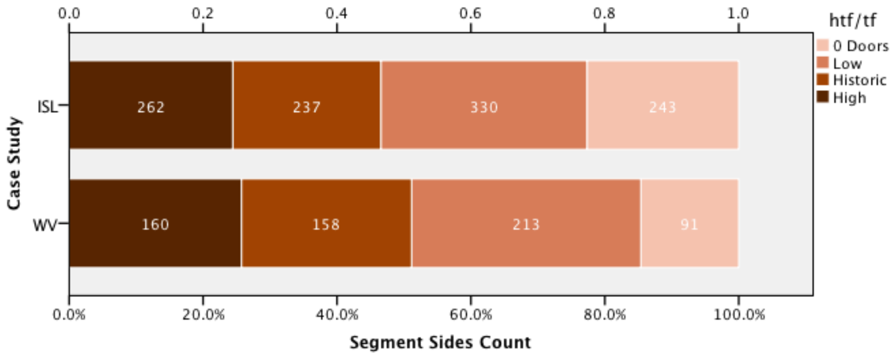


Figure 127. Case studies – *historical / current threshold frequency* for street sides.

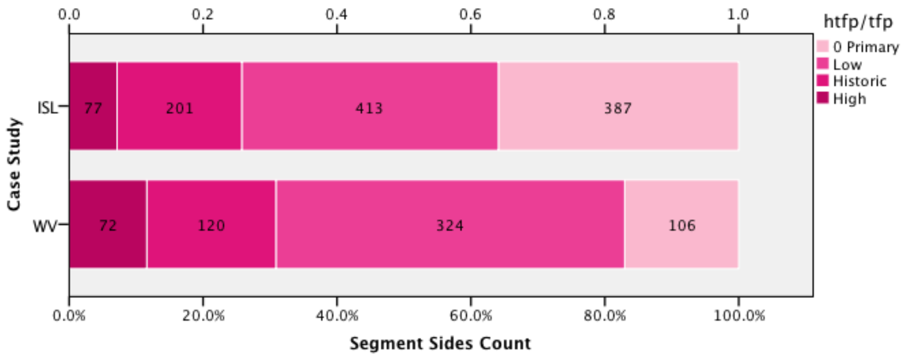


Figure 128. Case studies – *historical / current threshold frequency of direct entrances* for street sides.

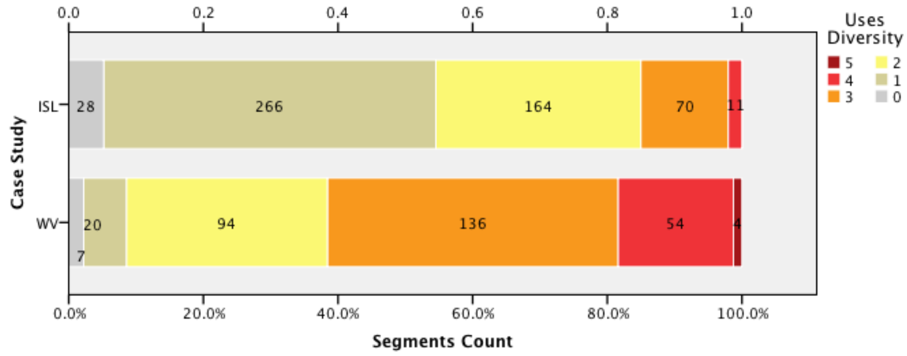


Figure 129. Case studies – *segment scale functional diversity*; the mixing of uses.

Finally, the two last graphs compare the 'urban' character of the two areas in terms of direct entrances (Figure 128) and of the functional profile (Figure 129) of the street interface. As discussed in the previous analytical chapters, direct building-street connections in combination with non-domestic uses imply a more public street interface and hence a potentially more sociable pavement micro-morphology. With regards to the threshold frequency of direct entrances, both areas have maintained to a similar extent their historical frequency (18.6% of block fronts in Islington and 19.3% in the West Village). However, there are marked differences in all three remaining groups (high, low and zero frequency). In general, dense block fronts with direct entrances are more common in the West Village (11.6%) whilst block fronts with no presence of direct building-street connections (17.0%) are less than half the number found in Islington (35.9%). At the same time, the West Village consists of street segments with greater functional diversity; note how in Figure 129 almost half of Islington street segments (49.3%) are mono-functional (namely, they present the same land use across the segment length), while only 6.3% of such segments are found in the West Village. In other words, buildings in the West Village have developed a more 'urban' profile than Islington from the point of view of building-street encounters, if we accept that diversity of uses is an indication of greater urbanity.

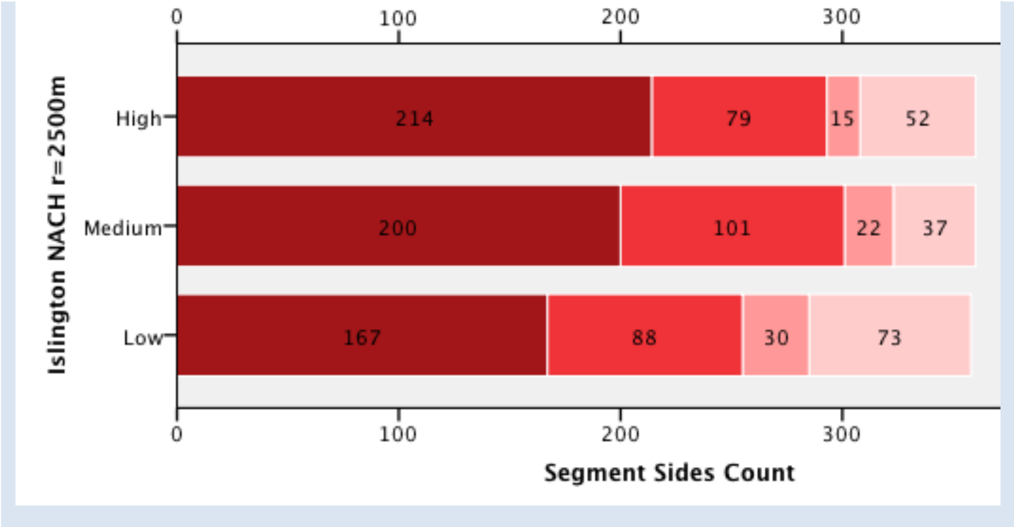
7.2.1. Interface Density

The following series of graphs shows each one of the *building-street interface* measures in relation to the properties of the local street network considered within its immediate city surroundings (using the large-scale catchment of 2500 meters radius). Here, since the chapter is driven by a comparative scope, syntactical calculations for the *normalised measures* are displayed. In the previous analytical chapters the relation of the *combined measure of integration and choice* to the properties of the street interface has been also explored in detail. Syntactical values for *normalised choice* (NACH) and *integration* (NAIN) are ordered by size and divided into tertiles to calculate the distribution for segment sides with *high*, *medium* and *low* syntax values.

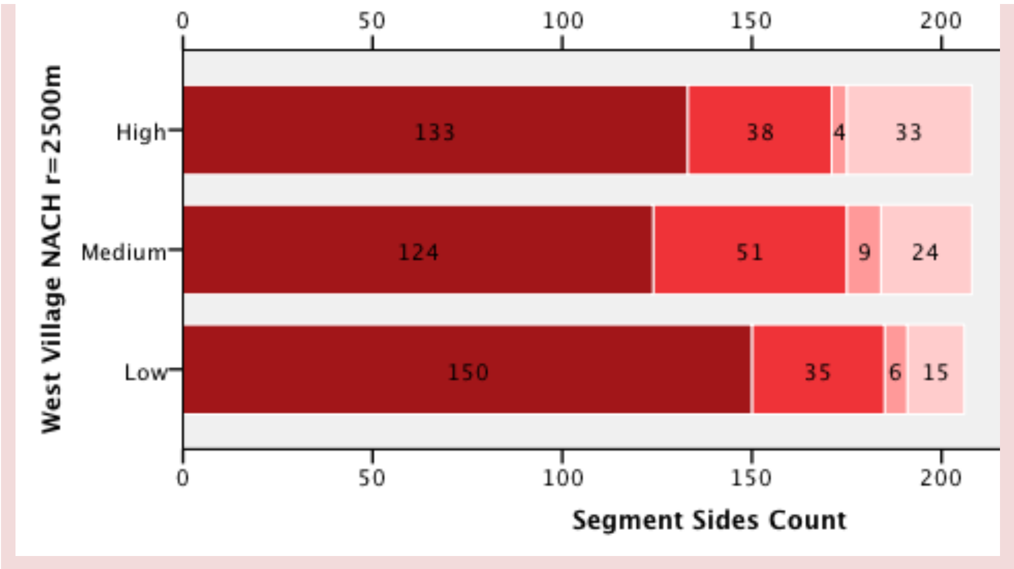
The *block front / segment length* ratio (Figures 130, 131). As seen above in Figure 122 shows that the West Village presents in general greater densification than Islington – another demonstration of Manhattan's historical quest to achieve maximum land coverage, prior to the technological advancements that allowed for the city's vertical expansion. It is interesting to note that the areas with the lowest syntactical values in Manhattan are the most built up (inversely to Islington). This is explained by the fact that in each case, where building development replaced the historical built form, a different block-scale morphology was imposed. In Islington many of the redevelopments relate to working-class housing in a typical 'slab' building setting[60]. Such housing was set back, away from the building line, leaving much of the block front free. In the West Village on the other hand, the most recent developments take up as much land as possible, with solid high-rise block fronts which shift the building scale dramatically.

[60] See Sherwood (1978) on modernist housing typologies in general and 'slabs' in particular (pp.113-135).

Each graphs shows on top the presence of buildings on street sides for the top third of normalised choice 2500 values for the case study area; in the middle: the presence of buildings for the middle third of normalised choice 2500 values; and at the bottom, the presence of buildings for the lowest third of normalised choice 2500 values.



Islington, London

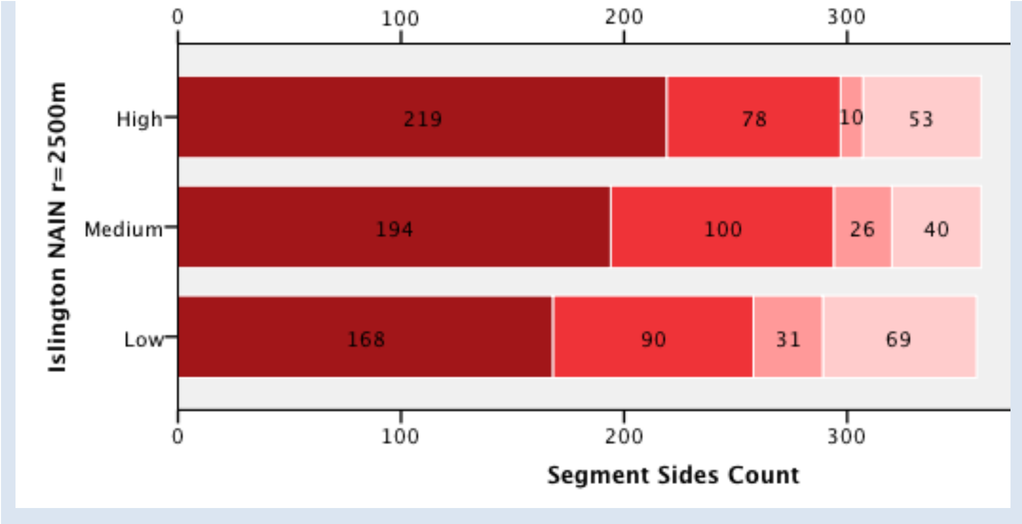


The West Village, Manhattan

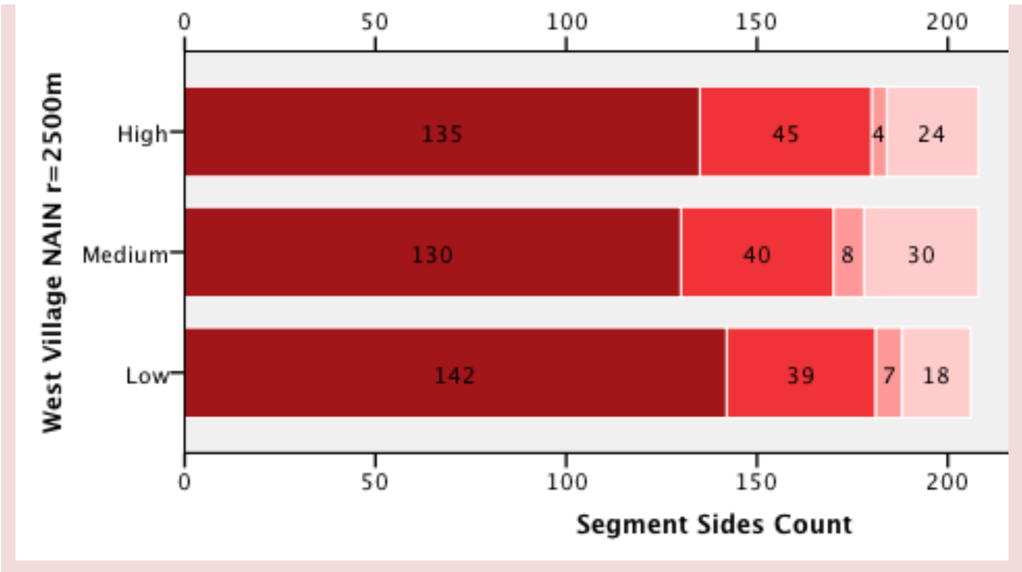
Figure 130. Case studies – the *block front length / segment length* in relation to *normalised choice R 2500 m* values, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

Each graphs shows on top the presence of buildings on street sides for the top third of normalised integration 2500 values for the case study area; in the middle: the presence of buildings for the middle third of normalised integration 2500 values; and at the bottom, the presence of buildings for the lowest third of normalised integration 2500 values.



Islington, London

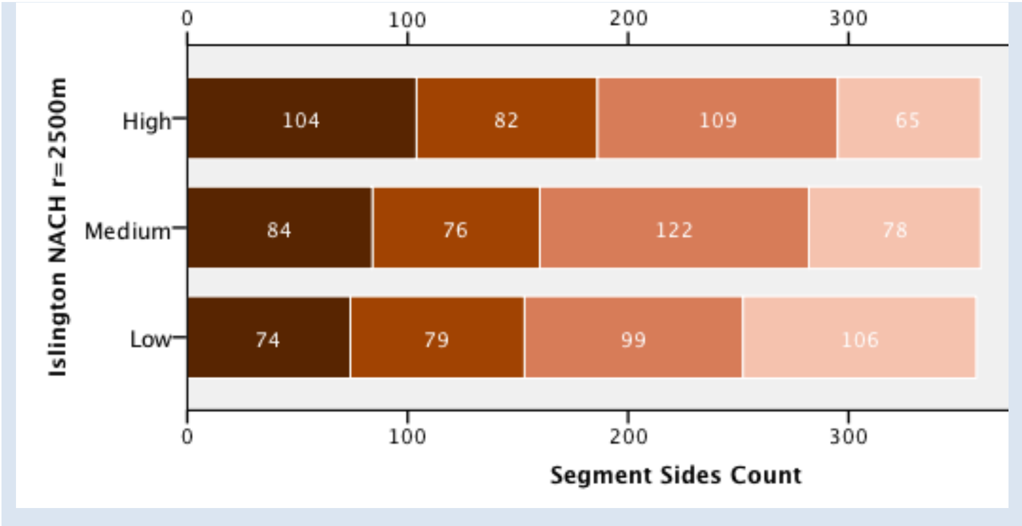


The West Village, Manhattan

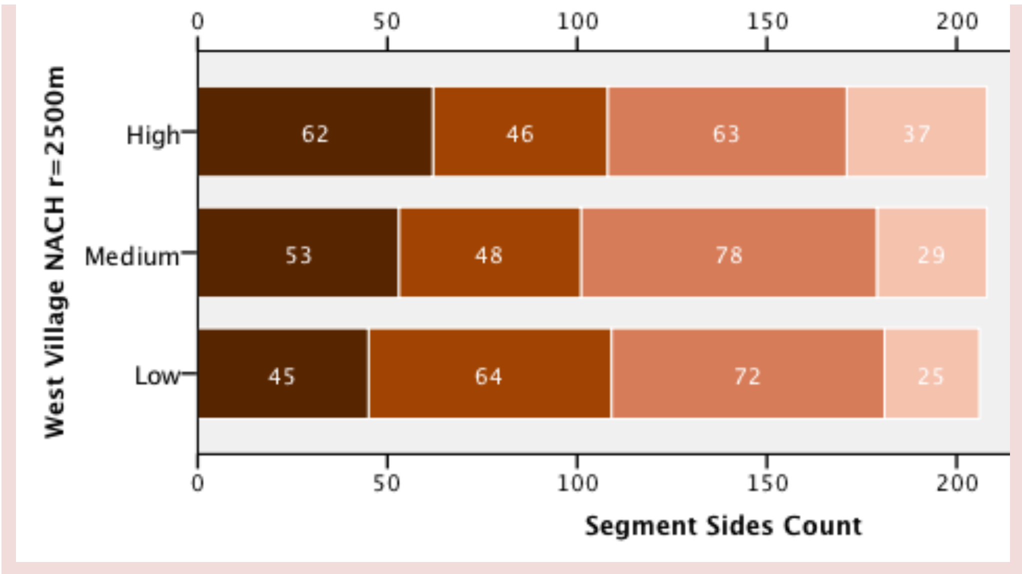
Figure 131. Case studies – the *block front length / segment length* in relation to *normalised integration R 2500 m* values, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

Each graphs shows on top the threshold frequency on street sides for the top third of normalised choice 2500 values for the case study area; in the middle: the threshold frequency for the middle third of normalised choice 2500 values; and at the bottom, the threshold frequency for the lowest third of normalised choice 2500 values.



Islington, London

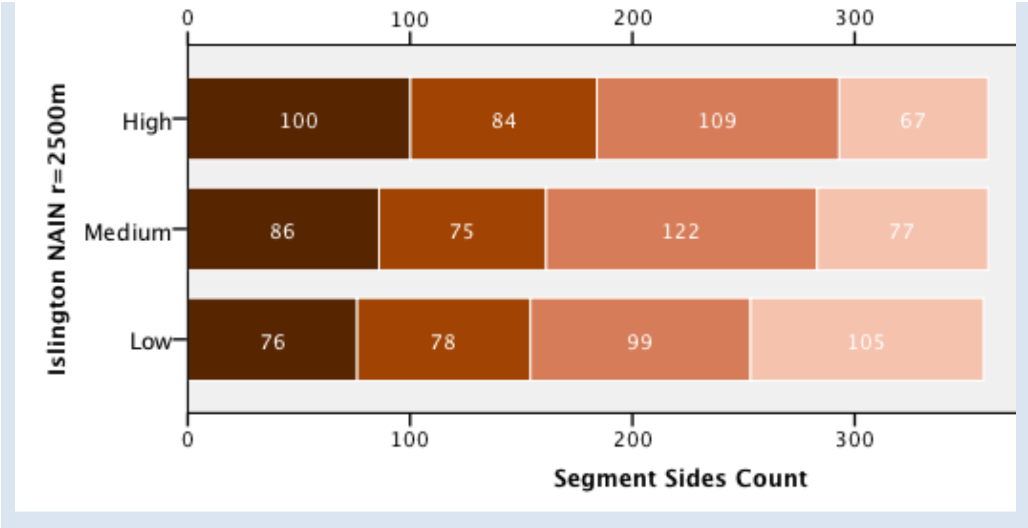


The West Village, Manhattan

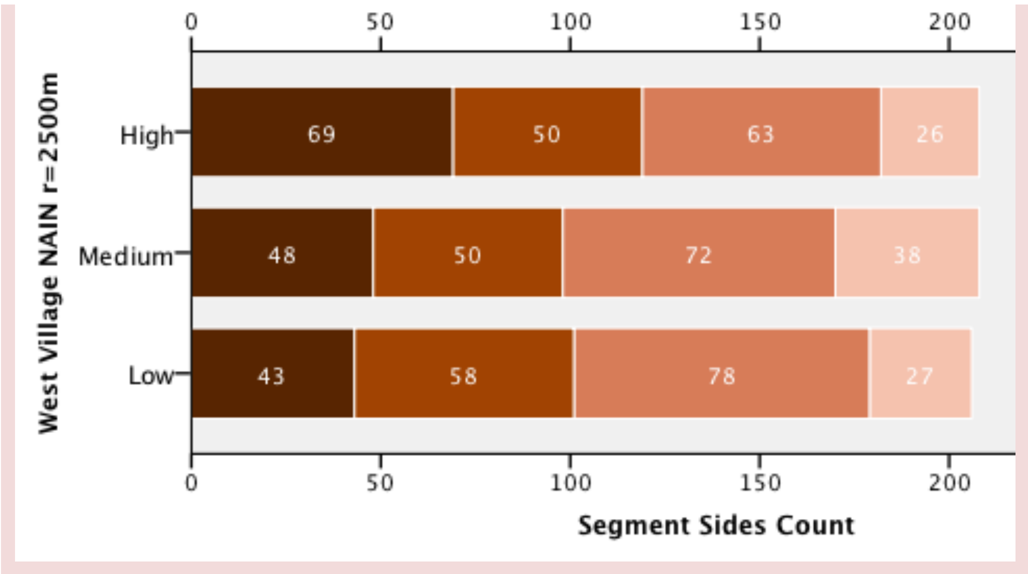
Figure 132. Case studies – the *historical / current threshold frequency* in relation to *normalised choice R 2500 m* values, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

Each graphs shows on top the threshold frequency on street sides for the top third of normalised integration 2500 values for the case study area; in the middle: the threshold frequency for the middle third of normalised integration 2500 values; and at the bottom, the threshold frequency for the lowest third of normalised integration 2500 values.



Islington, London



The West Village, Manhattan

Figure 133. Case studies – the *historical / current threshold frequency* in relation to *normalised integration R 2500 m* values, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

The *historical threshold frequency / current threshold frequency* ratio distribution (Figures 132, 133) shows a marked consistency across the two case studies in regards to the relation between configuration and change in doorway encounters. The number of streets segment sides which have developed a higher threshold frequency than the historical streetscape (dark brown bar portions in graphs) appears to decrease when moving from higher to lower syntactical values (in both areas and for both normalised choice and integration). This is an indication that segments with higher movement potential (higher syntactical values in terms of accessibility and permeability) are more likely to become denser in virtual encounters over time.

Another important observation can be made here concerning the locations where a change in built form occurs. This is based on the hypothesis that where a street façade with a lower interface density than the typical historical block front is observed, a significant change in the property's built form is implied; a building may become denser in entrances, but it is rare that it would become more sparse. In other words, in street façades with lower interface densities it is quite likely that building demolition or replacement has taken place. By comparing the graphs for Islington and the West Village, it can be seen that urban change has strongly affected the street interfaces in both cases (bar portions showing 'low' and 'zero' groups). However, it appears that this change in built form has been more radical in Islington, especially in segments with middle and low syntactical values. This can be confirmed by the large demolitions that took place in the area (such as the blocks of the Peabody Trust and Britannia Row). Recalling the discussion in the second chapter around the street structure and building aggregation rules of London, two reflections can be made:

- Firstly, that change patterns in Islington potentially follow a hierarchical logic, related to the hierarchy that underpins the city grid overall: areas which are less connected are more prone to radical urban transformation, while areas associated with the foreground network persist in their fundamental building and plot form, via both continuity and change. Whilst the statistical results seem to support this hypothesis, they also point to a potential route for a future research inquiry.

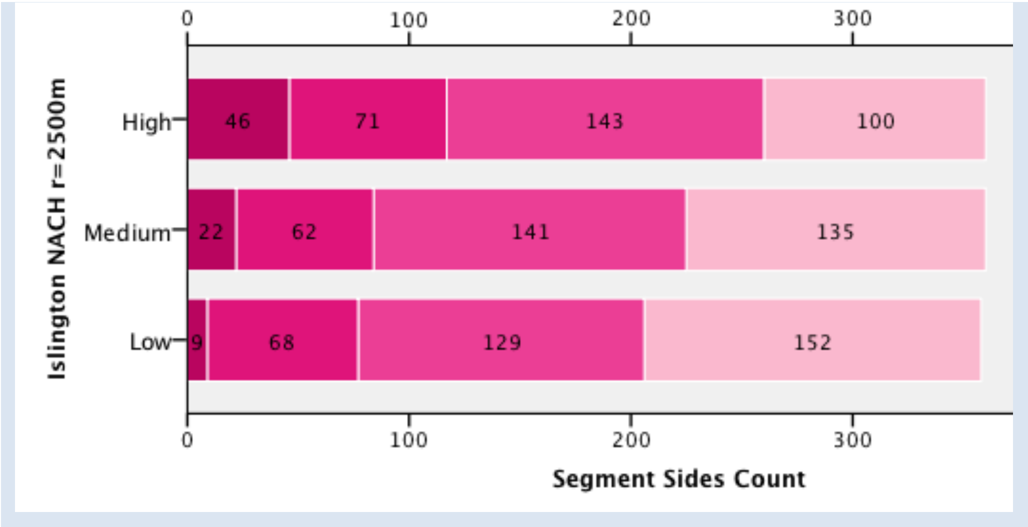
- Secondly, a main feature of the terrace morphology was that the row performed as the primary urban building unit. The piecemeal transformations seen in the West Village were discouraged by this building culture, and by the aesthetic treatment of the façade, which is frequently designed as a uniform whole, as discussed in Chapter 3). This is another factor contributing to the large-scale transformations seen in Islington, with its tendency to terrace-wide uniformity of design.[61]

These interpretations lead back to the historical interplay of street network and built form properties. The West Village presents a far more probabilistic field with regards to both street configuration and built form than Islington, and here change – in terms of lower interface densities – appears to be relatively equally distributed across the street sides.

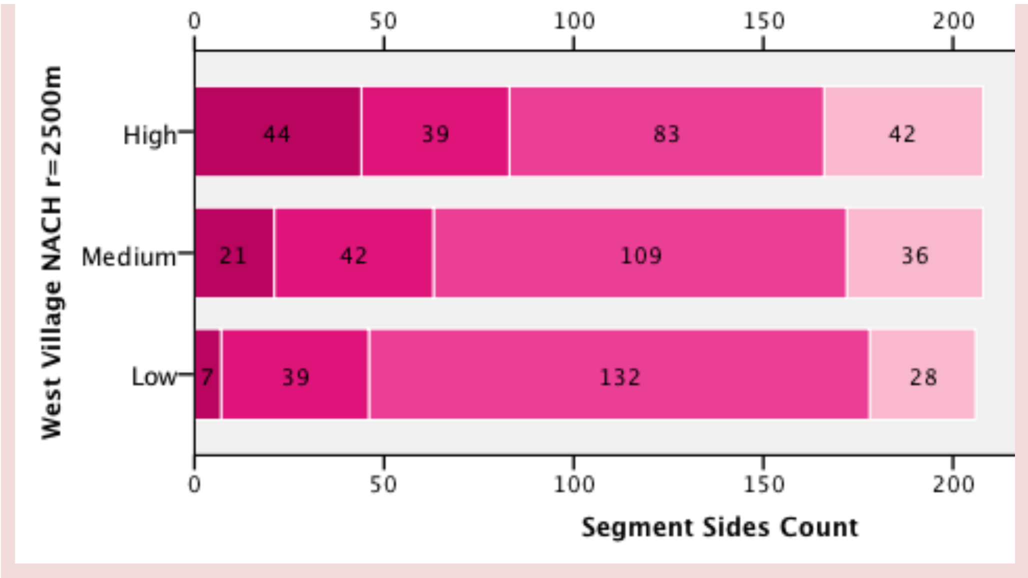
Finally, the *historical threshold frequency / current threshold frequency* ratio of *primary thresholds* distribution (Figures 134, 135) establishes further the relation between interior-exterior encounter density and street network. The graphs shown here indicate clearly that segment sides in the most accessible locations of the grid (those with high values) present the highest percentages of block fronts which have become denser in primary thresholds over time; i.e., the have developed greater potential for immediacy in probabilistic interior-exterior encounters. This reinforces the findings shown in Figures 132, 133 above. Also, complementing observations from the previous graphs (showing the *htf/tf* measure), we can see that block fronts in street segment sides of lower syntactical values are relatively dense in their thresholds, but this density refers to indirect building thresholds rather than direct building entrances.

[61] Of course, there are other factors that affect the scale of urban change, such as the 'economic driver' of developments, being individuals, developers or governmental acts.

Each graphs shows on top the frequency of direct thresholds on street sides for the top third of normalised choice 2500 values for the case study area; in the middle: the frequency of direct thresholds for the middle third of normalised choice 2500 values; and at the bottom, the frequency of direct thresholds for the lowest third of normalised choice 2500 values.



Islington, London

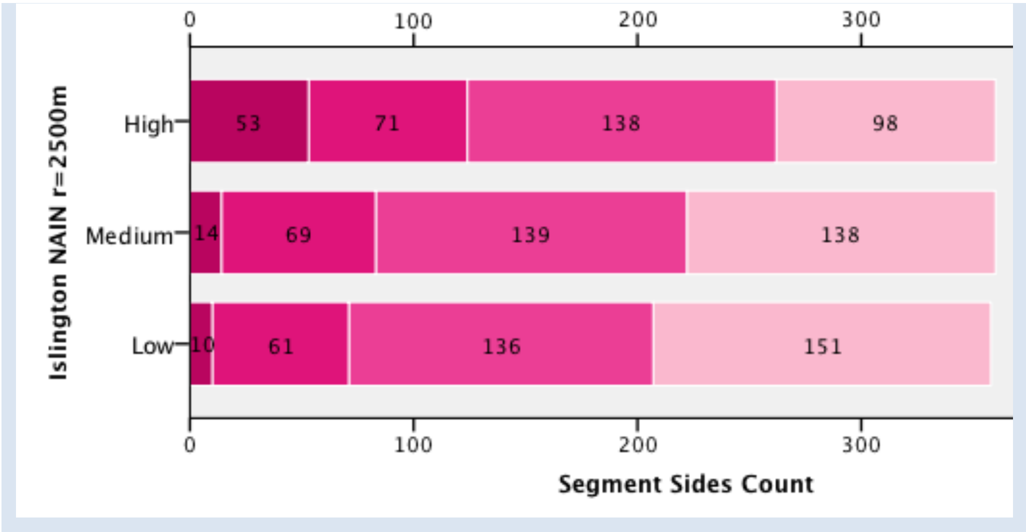


The West Village, Manhattan

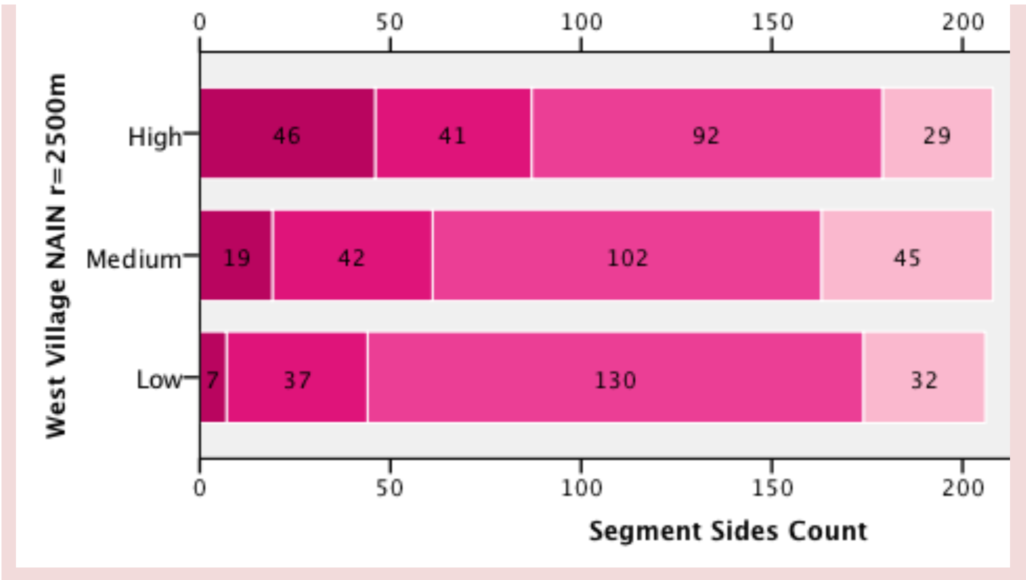
Figure 134. Case studies – the *historical / current frequency of direct thresholds* in relation to *normalised choice R 2500 m* values, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

Each graphs shows on top the frequency of direct thresholds on street sides for the top third of normalised integration 2500 values for the case study area; in the middle: the frequency of direct thresholds for the middle third of normalised integration 2500 values; and at the bottom, the frequency of direct thresholds for the lowest third of normalised integration 2500 values.



Islington, London



The West Village, Manhattan

Figure 135. Case studies – the *historical / current frequency of direct thresholds* in relation to *normalised integration R 2500 m* values, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

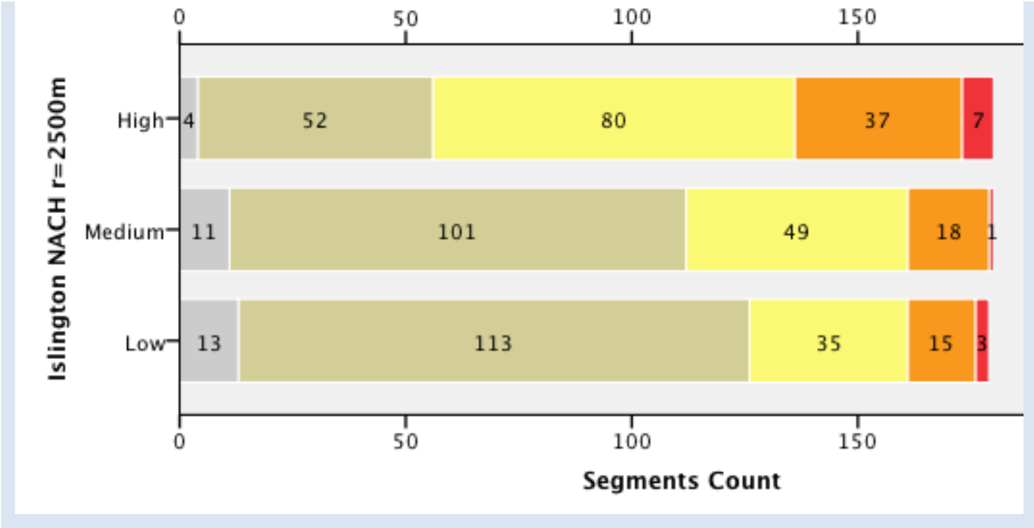
7.2.2. Mixing of uses

Another point of note when considering the varying qualities in the street sections analysed is the impact of building function on the configuration of the building-street relationship. Varying building uses in close proximity create a diverse sidewalk micromorphology and therefore a difference in user encounters. In turn it is of interest to examine whether there is any relation between the street network and the distribution of land use diversity (measured here by a simple count of the number of different land uses that appear across the segment length) within the city realm. As has been mentioned, when commenting on the city structures of London and Manhattan, Hillier et al. (2012) describe both networks as possessing economically driven configurations. The authors point out that in London, city-wide economic activities follow the lines of the foreground street network, whilst in Manhattan the street gridiron supports a relatively higher level of equal economic opportunity across the city districts. A relevant pattern of functional diversity in Islington and the West Village is revealed when relating the degree of diversity in the individual building use of a segment to the segment's configurational properties (Figures 136, 137). Use diversity per segment in Islington is in line with each segment's accessibility potentials, while in the West Village land use diversity per segment is equally distributed across the whole range of syntactical values. Overall, the latter case study presents street interfaces with greater functional mixing, illustrating how the 'urban buzz' – in the sense of diverse probabilistic encounters and co-presence (Hillier, 1996, p.126) – is spread widely throughout the West Village area.

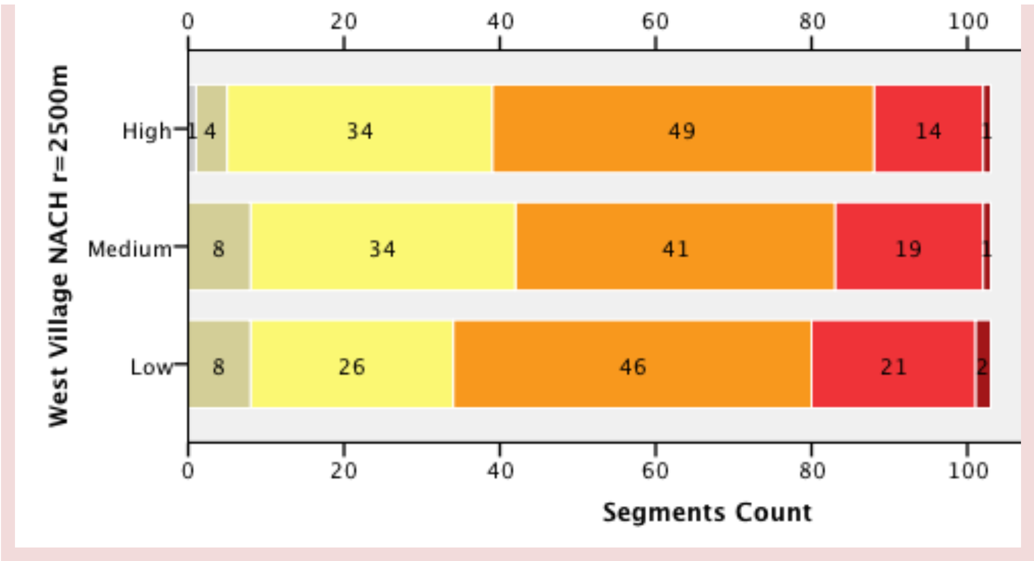
7.2.3. Segment Length

A final important observation relates to short blocks (and respectively short street segments) and their greater potential for higher *permeability* and *accessibility* in comparison to longer blocks. The graphs in Figures 138 and 139 confirm that in both case studies longer street segments frequently correspond to lower syntactical values both in terms of choice and integration. Indeed, across the range of values with the highest movement potential, a significant majority of segments are short, with a length of 50 metres up to as much as 100 meters (the second shortest 'group' of segments). The fact that the two grids have different geometries (irregular for London, orthogonal for Manhattan) validates these results.

Each graphs shows on top the mixing of uses on street segments for the top third of normalised choice 2500 values for the case study area; in the middle: the mixing of uses for the middle third of normalised choice 2500 values; and at the bottom, the mixing of uses for the lowest third of normalised choice 2500 values.



Islington, London

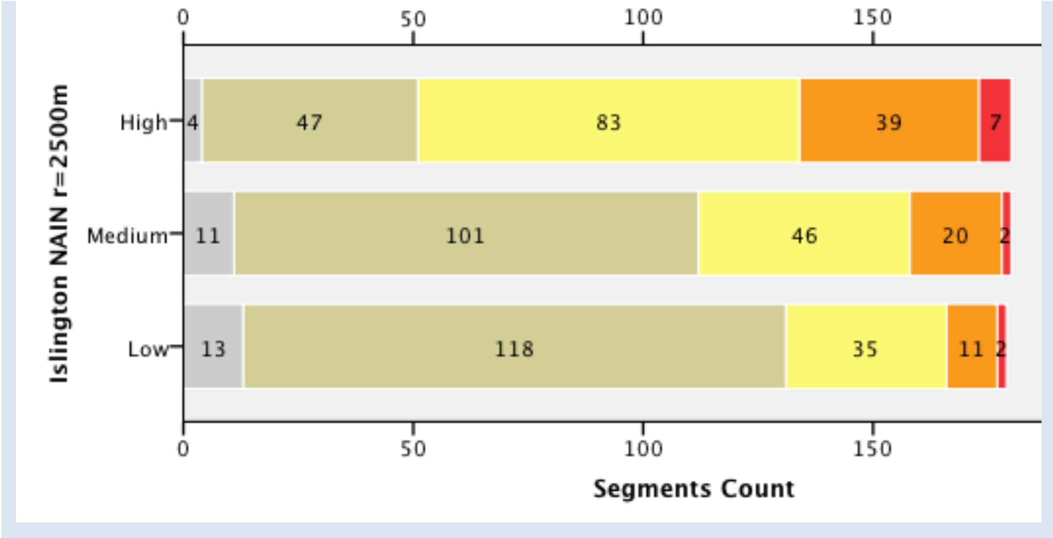


The West Village, Manhattan

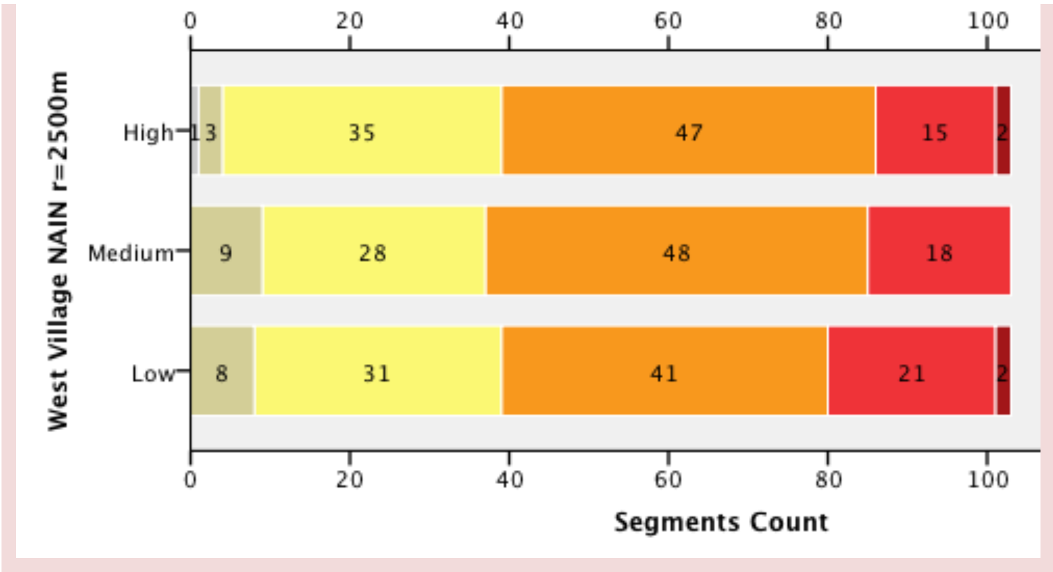
Figure 136. Case studies – the *mixing of uses* in relation to *normalised choice R 2500 m* values, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

Each graphs shows on top the mixing of uses on street segments for the top third of normalised integration 2500 values for the case study area; in the middle: the mixing of uses for the middle third of normalised integration 2500 values; and at the bottom, the mixing of uses for the lowest third of normalised integration 2500 values.



Islington, London

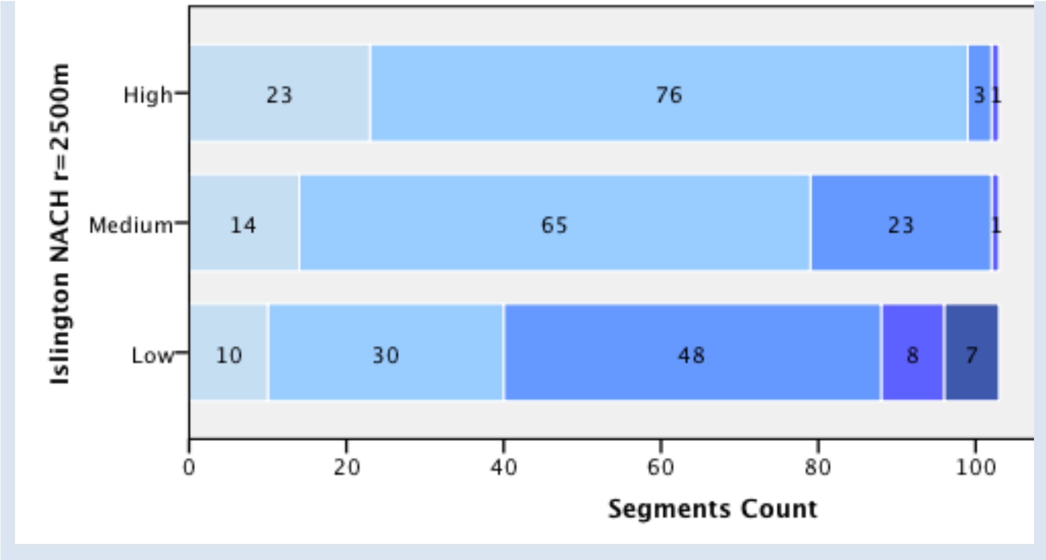


The West Village, Manhattan

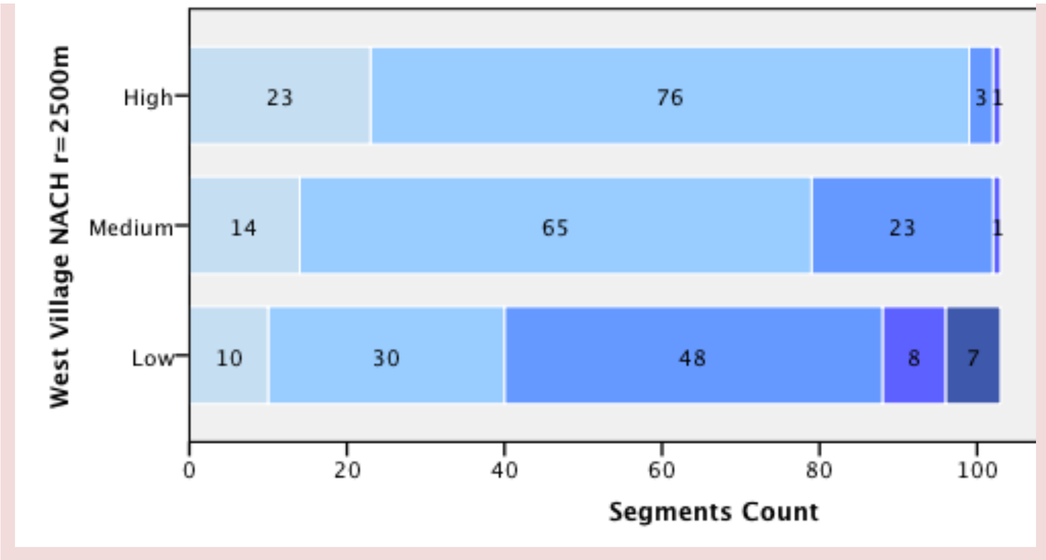
Figure 137. Case studies – the *mixing of uses* in relation to *normalised integration R 2500 m* values, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

Each graphs shows on top the segment length on street sides for the top third of normalised choice 2500 values for the case study area; in the middle: the segment length for the middle third of normalised choice 2500 values; and at the bottom, the segment length for the lowest third of normalised choice 2500 values.



Islington, London

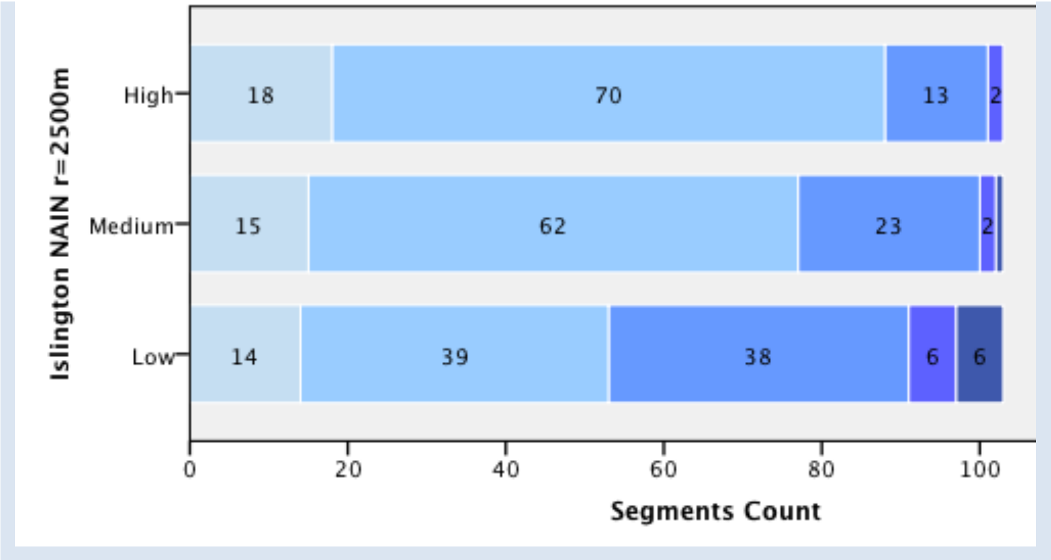


The West Village, Manhattan

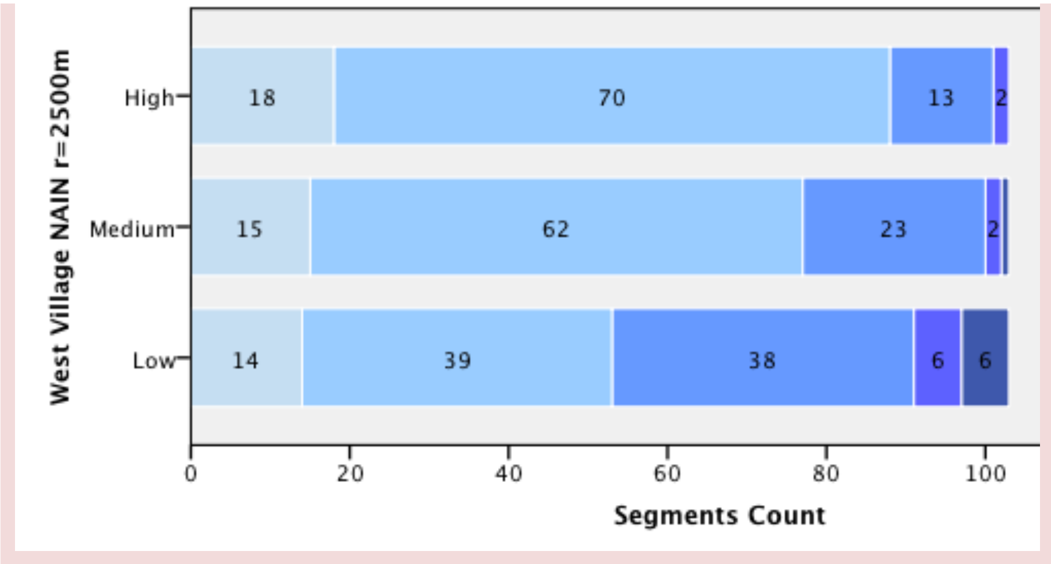
Figure 138. Case studies – the *segment length* in relation to *normalised choice R 2500 m* values, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

Each graphs shows on top the segment length for the top third of normalised integration 2500 values for the case study area; in the middle: the segment length for the middle third of normalised integration 2500 values; and at the bottom, the segment length for the lowest third of normalised integration 2500 values.



Islington, London



The West Village, Manhattan

Figure 139. Case studies – the *segment length* in relation to *normalised integration R 2500 m* values, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

7.3. Built form and street interfaces

The second line of inquiry in this study is that of the role of the row house form in contributing to the 'liveability' of the sidewalk. The work of Julienne Hanson has established the relationship between architectural morphology and lively street interfaces, showing that there are outward building morphologies which increase the potential for probabilistic encounters, just as there is an impairment of the probabilistic encounter field in cases where the building-street interface has been 'ruptured' (Hanson, 2000). Following Hanson's research on urban transformations, the analysis here aimed to further explore the architectural principles which support a lively street interface over time, by enhancing longevity and adaptability. This raises the question: *does longevity and adaptability in the built form account for places which maintain or multiply their potentials for probabilistic encounter and co-presence over time*?

To begin with, it is essential to recall the presence of surviving historical buildings in the two case studies (Figure 140). The study focused on the most typical building type in each case: ordinary urban houses, namely the terraced house in London and the row house in Manhattan. This allowed for a comparable historical exploration – covering a period of over a century – of the longevity and adaptability of the two building types. In general, terraced houses comprise approximately 25 per cent more of the building stock in Islington than the equivalent proportion for row houses in the West Village, further proof that the Village has presented a far more challenging setting for the preservation of the historical building type, despite the fact that its conservation status dates to the same time as that of Islington (as mentioned above: both areas are of comparable size were designated for conservation in 1969), as will be elaborated in the following section.

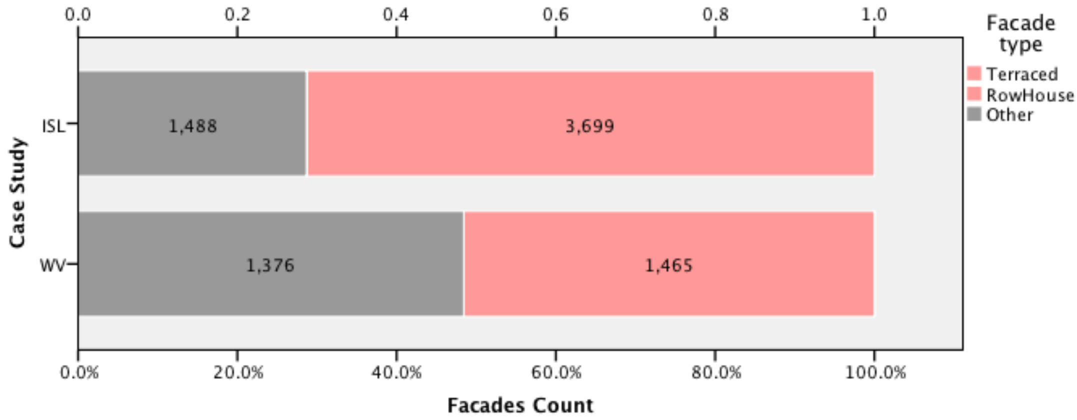


Figure 140. Case studies – the presence of historical building types;

Showing the percentages of *surviving terraced houses* in Islington (top) and *row houses* in the West Village (below) in relation to *'other' non-historical buildings*.

In both instances the surviving historical built form has an interface density which exceeds that of other existing building morphologies: Figure 141 shows that terraced house façades in Islington, similar to row house façades in the West Village (in Figure 142), are found in street segment sides which are built up almost across the entire segment length (see *bf/sl* distribution). More than half of these historical façades form block fronts which have accumulated a greater number of building-street thresholds along their length over time (see *htf/tf* percentages). Whilst stoops and area-ways are typical modes of transition for row housing schemes to form indirect building-street relations, it is nevertheless evident that in both areas row housing is overwhelmingly the most likely type of building to form direct entrances within block fronts – indeed, it is more likely than all other building typologies put together (see *htfp/tfp* percentages).

To reverse this analysis, the graphs in Figures 143-145 illustrate that the denser street sides are almost wholly comprised of the two historical building types. At the same time, it is interesting to note that almost 90 per cent of street sides with no doorways (blank walls) contain buildings *other than* terraced and row houses.

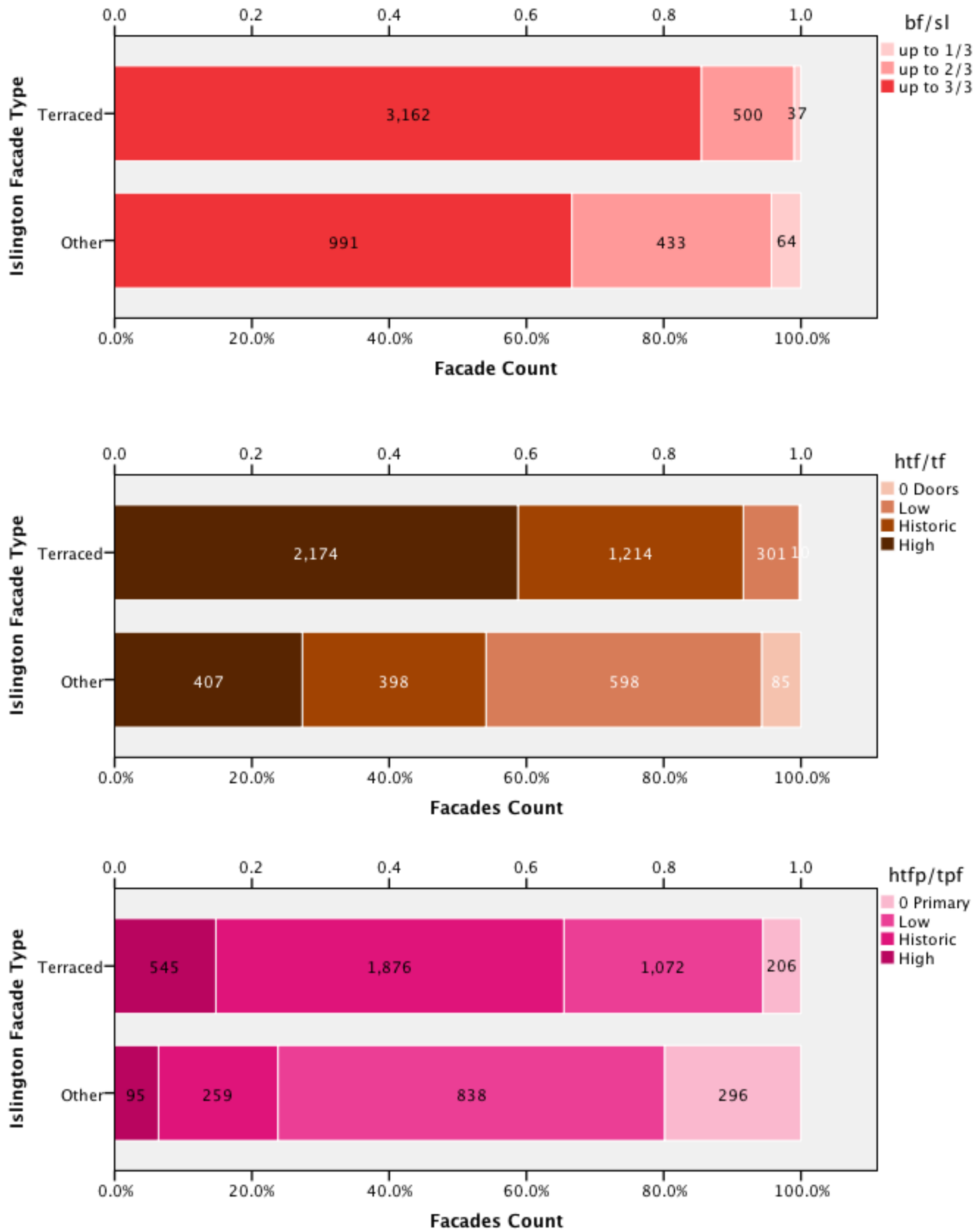


Figure 141. Islington, London – the presence of historical building types. (c.2013)

Showing the percentages of *terraced houses* in Islington (top bar in graphs) in relation to *'other' buildings*, for:

(a) the block front length / segment length distribution (top)

(b) the historical / current threshold frequency distribution (middle)

(c) the historical / current threshold frequency for direct thresholds distribution (below).

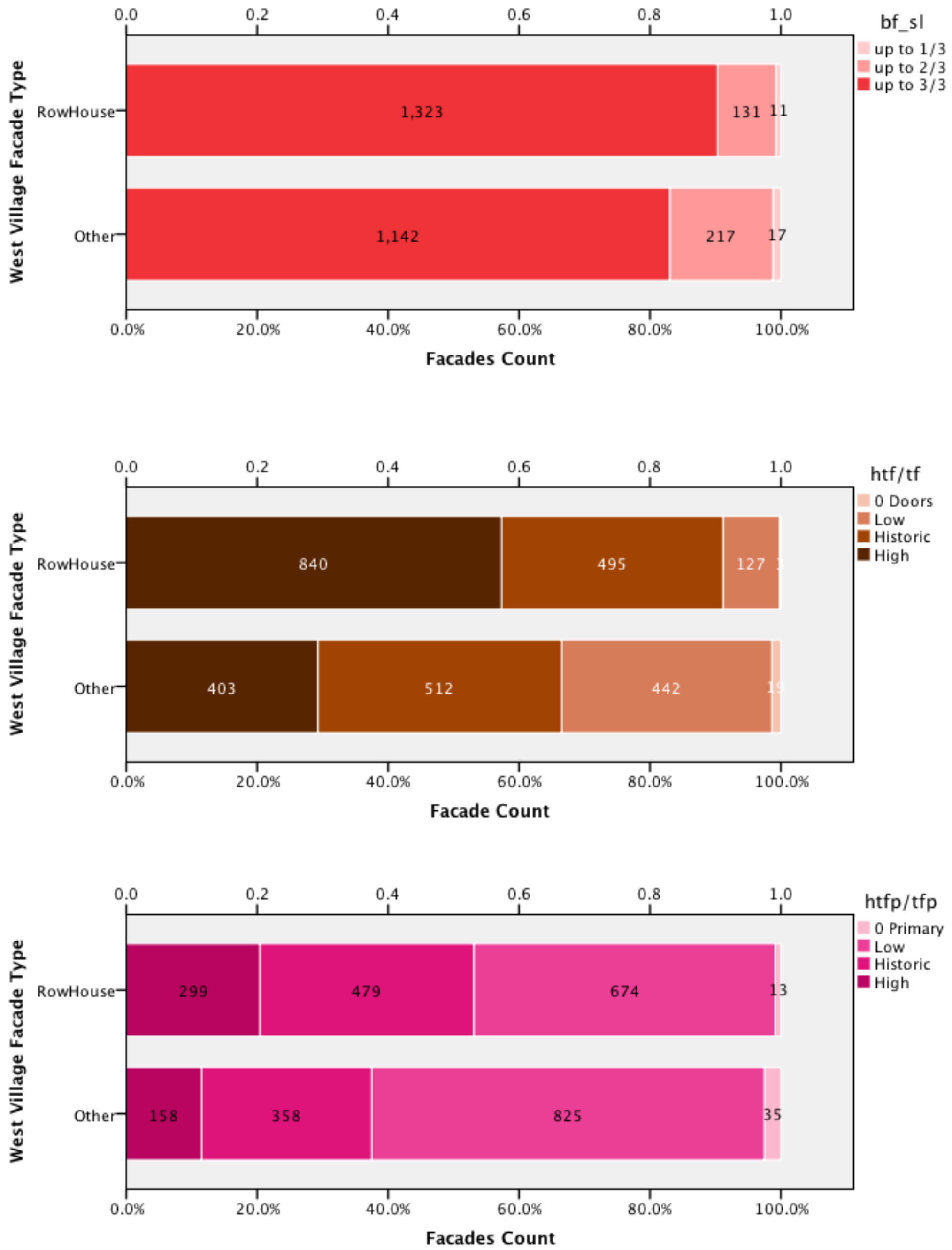


Figure 142. The West Village, Manhattan – the presence of historical building types. (c.2011)

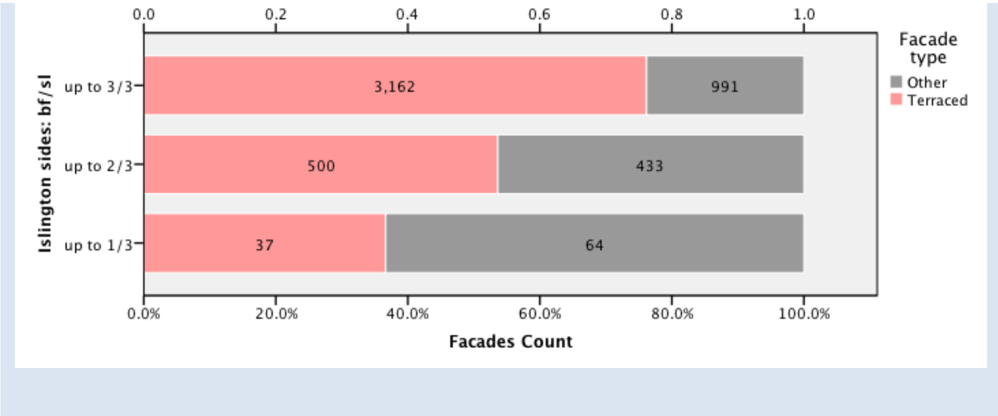
Showing the percentages of *row houses* in the West Village (top bar in graphs) in relation to *'other' buildings*, for:

(a) the block front length / segment length distribution (top)

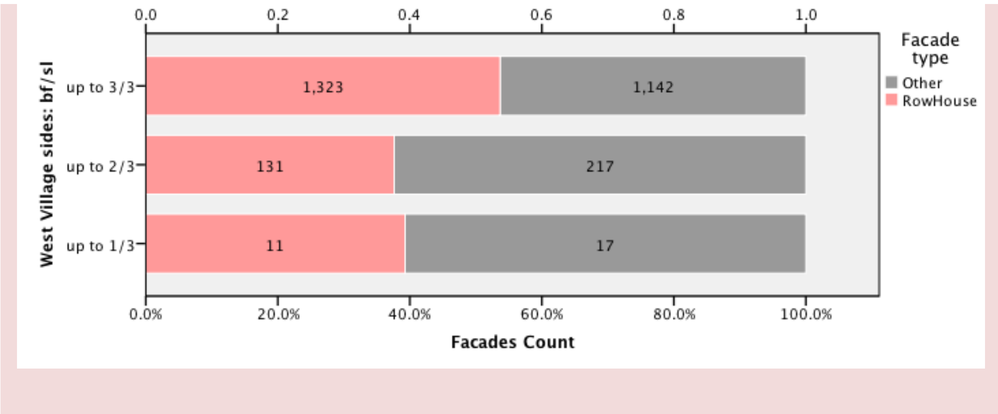
(b) the historical / current threshold frequency distribution (middle)

(c) the historical / current threshold frequency for direct thresholds distribution (below).

Each graphs shows on top the presence of historical buildings on street sides for the top third of block front / segment length distribution for the case study area; in the middle: the presence of buildings for the middle third of block front / segment length distribution; and at the bottom, the presence of buildings for the lowest third of block front / segment length distribution.



Islington, London

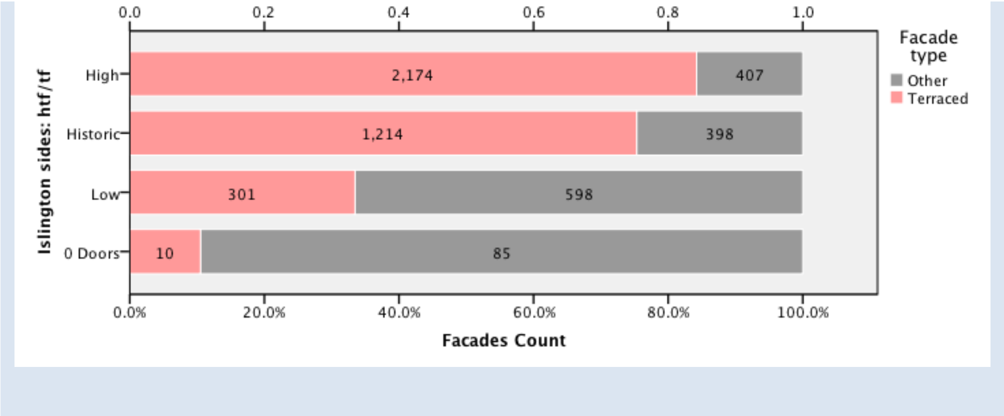


The West Village, Manhattan

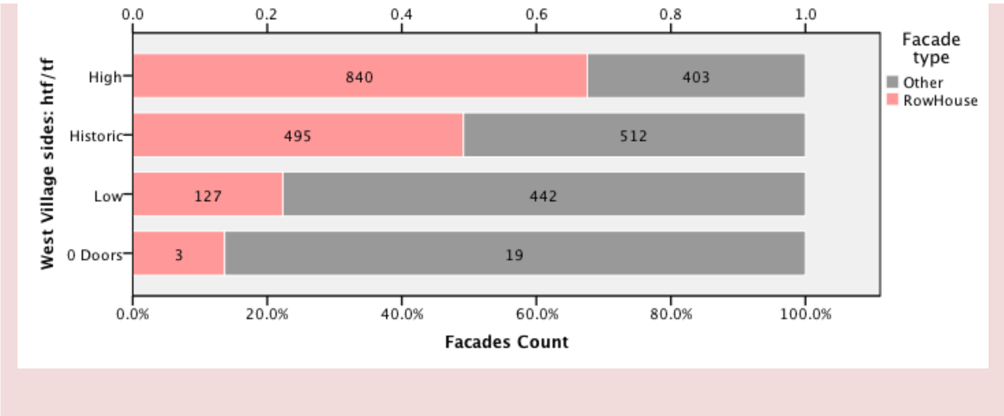
Figure 143. Case studies – the *presence of historical building types* in relation to *block front / segment length distribution*, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

Each graphs shows on top the presence of historical buildings on street sides for the top third of the threshold frequency distribution for the case study area; in the middle: the presence of buildings for the middle third of the threshold frequency distribution; and at the bottom, the presence of buildings for the lowest third of the threshold frequency distribution.



Islington, London

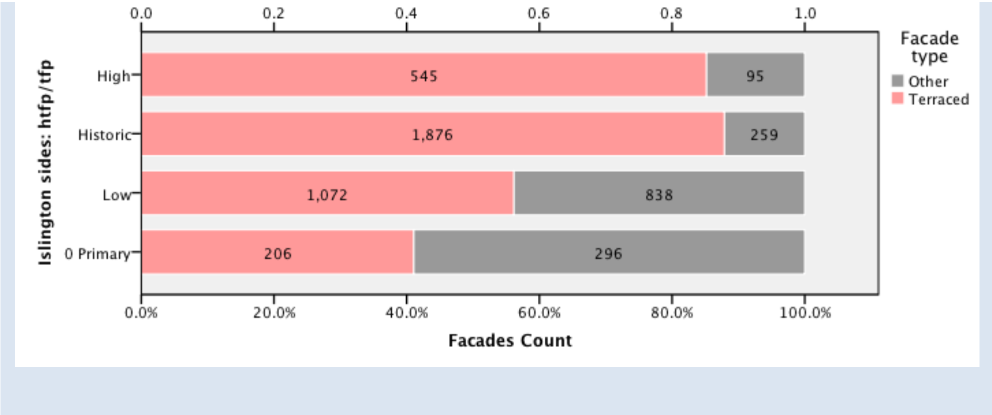


The West Village, Manhattan

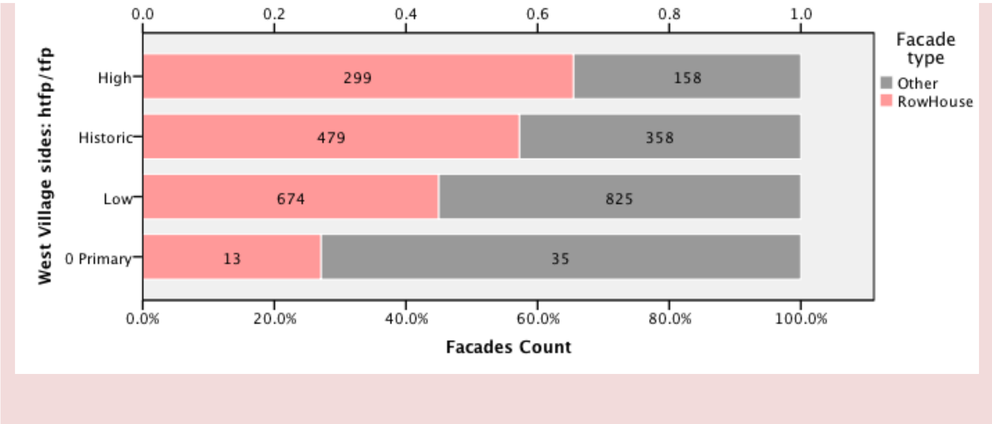
Figure 144. Case studies – the *presence of historical building types* in relation to *historical / current threshold frequency distribution*, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

Each graphs shows on top the presence of historical buildings on street sides for the top third of the frequency of direct thresholds distribution for the case study area; in the middle: the presence of buildings for the middle third of the frequency of direct thresholds; and at the bottom, the presence of buildings for the lowest third of the frequency of direct thresholds.



Islington, London



The West Village, Manhattan

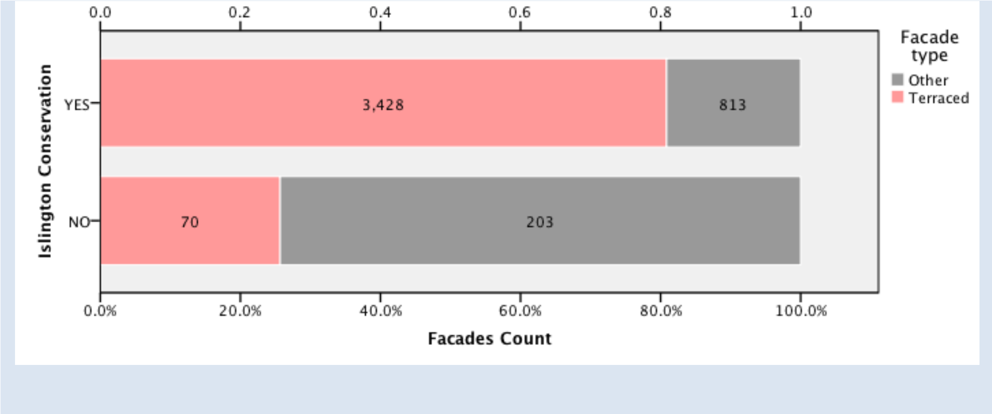
Figure 145. Case studies – the *presence of historical building types* in relation to *historical / current frequency of direct thresholds distribution*, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

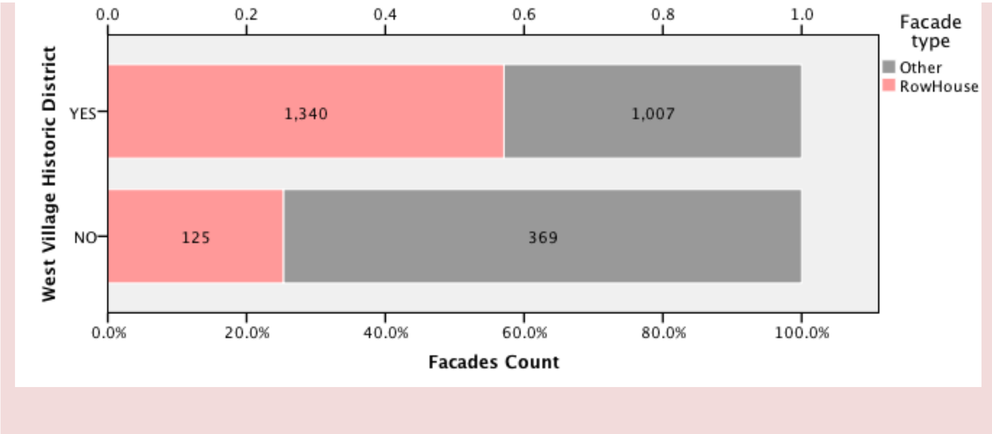
7.4. External forces: conservation and Historic District designation

Besides the street network and built form properties, in both case studies there is another – external, yet pivotal – factor which has played a fundamental role in shaping the streetscape: the provision of protection of the historical building stock via building and planning regulations. Conservation areas in Islington and Historic District designations in the West Village were established in 1969 and brought about a shift in the course of built form events and transformations that followed thereafter.

Figure 146 summarises the significant input of these policies in preserving the historical 'ordinary' urban houses within the two case study areas. The figure shows the number of historical façades which fall within protected areas v. those which fall outside. Whilst one should take account of the fact that the conservation areas for Islington and the West Village actually extend beyond their study area, the analysis is effectively measuring whether or not a terraced house has been retained (comparing between buildings that fall inside or outside the boundaries of conservation areas), rather than its proportion from all buildings in each area. These stark differences suggest that without these provisions for conservation, terraced houses and row houses would by now have become extinct, consumed by the processes of urbanisation. The requirement for higher densities and improvements in living conditions, technological advancements, and speculative development are some of the many factors that can lead to the replacement of older, ordinary urban houses (Guillery, 2005). In Islington four out of five buildings in conservation areas are terraced houses (80.8%). In streets outside conservation areas the situation is almost reversed and very few terraced houses remain: just one in four buildings is a terraced house (25.6%). In the West Village, historical row houses have clearly been subjected to a greater threat of demolition. Within the Historic Districts in the area, almost three out of five buildings are row houses (57.1%); outside the designated areas, the situation is very similar to Islington, with row houses making up only a quarter of buildings (25.3%).



Islington, London



The West Village, Manhattan

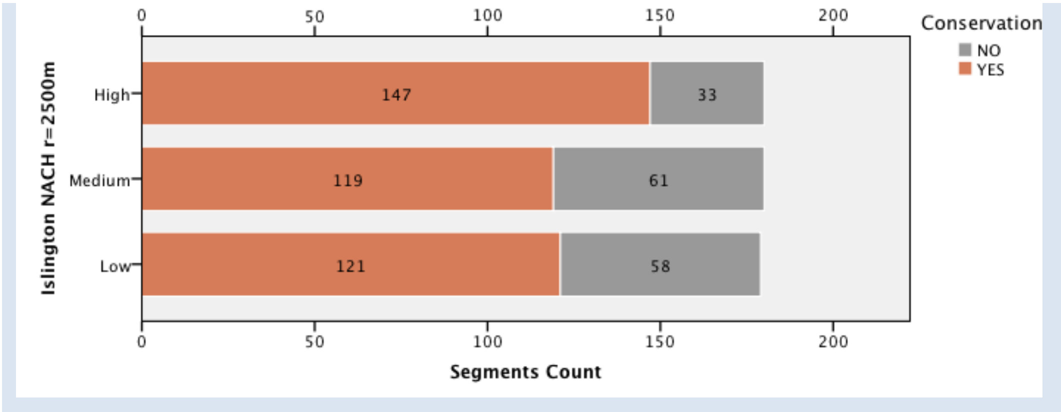
Figure 146. Case studies – the *presence of historical building types* in *conservation* (top bar on graphs) and *non-conservation* areas.

Showing Islington (top) and the West Village (below).

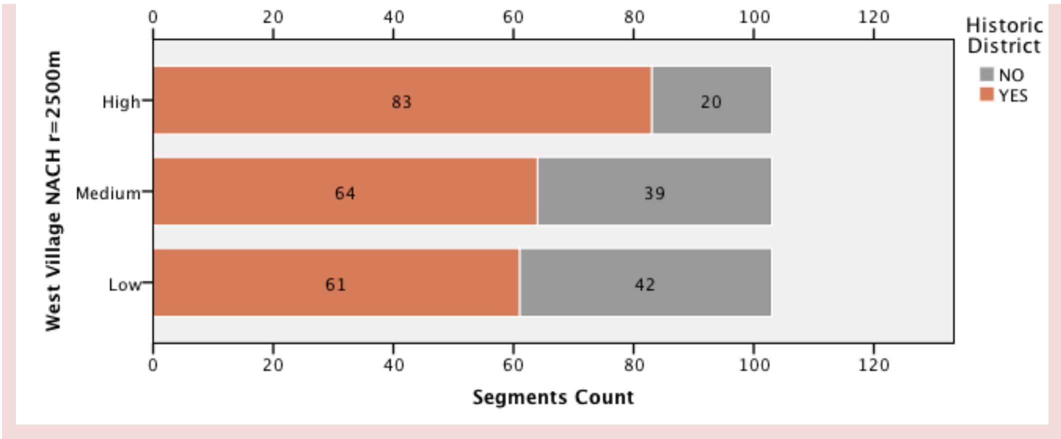
Whilst determining where, and to what extent, urban change occurs presents a complexity that is difficult to unravel, there has been an effort to follow the spatial logic of urbanisation by investigating the narratives of the built form in Islington and the West Village. In Islington this has involved a visit to the past using as a vehicle Charles Booth's mappings and notebooks (c.1898-9). Booth's descriptions were considered in relation to the properties of the historical street network (c.1910, 1965, 2013). In the case of the West Village, Bromley & Co. Fire Insurance Maps were studied in detail in order to record built form alterations and demolitions across two time periods (c.1921-1955 and c.1955-2013). Again, these recordings were compared to the properties of the historical Manhattan grid (c.1891, 1921, 1955, 2011). This temporal analysis allowed certain urban phenomena and temporal patterns of urban change to be considered as parts of urban processes. For instance, in studying the socio-spatial functioning of the West Village, it was shown that transformations in the grid generated a series of multiplier effects which have continued to have an impact on building form and function long after their manifestation; this observation highlights the importance of *historical research* and *diachronic processes* in understanding the nature of urban evolution within the unique context of each city.

Another important pattern of urban change is summarised in Figures 147 and 148. The graphs measure the allocation of street segments which are currently 'under protection' in bands of high-to-low syntactical values. Taking into account the fact that the designation of conservation/Historic Districts presumes the strong presence of historical built form context, it can be inferred that conservation implies *continuity* and non-conservation indicates significant *change*. It can be seen, then, that the streetscape in Islington and the West Village has been shaped by both continuity and change throughout. However, it seems that *persistence* is stronger in more accessible parts of the grid, particularly in the West Village (and hence richer in user encounters and in morphological and functional density and diversity), leading us back to the question: does the relationship between the *longevity* and *probabilistic micromorphology* of streets work in both directions?

Each graphs shows on top the street sides falling within and outside conservation areas for the top third of normalised choice 2500 values for the case study area; in the middle: the street sides falling within and outside conservation areas for the middle third of normalised choice 2500 values; and at the bottom, the street sides falling within and outside conservation areas for the lowest third of normalised choice 2500 values.



Islington, London

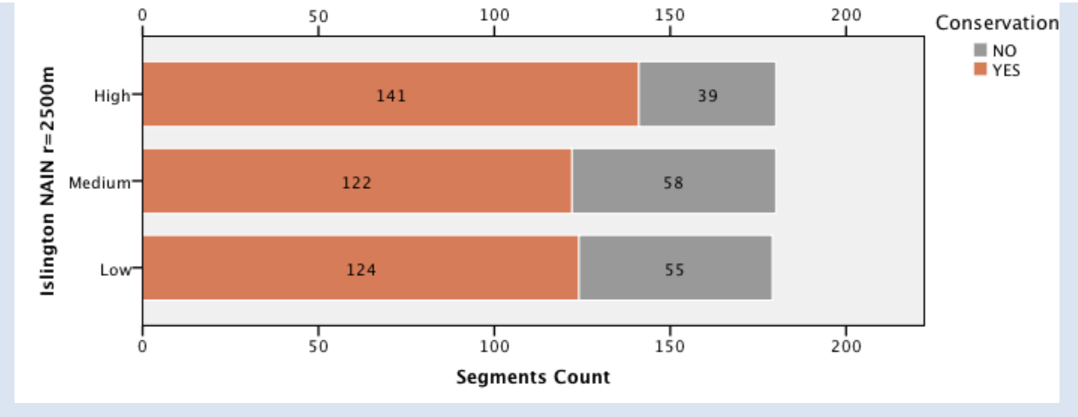


The West Village, Manhattan

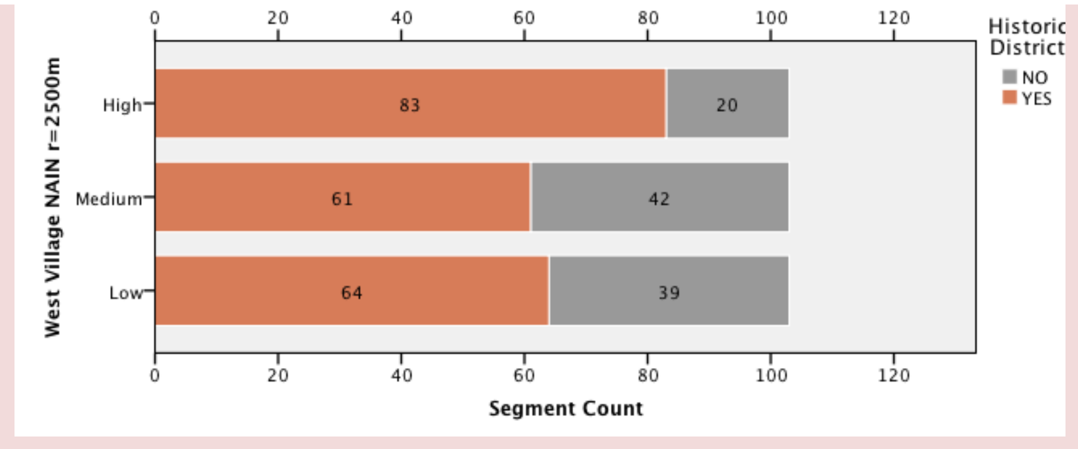
Figure 147. Case studies – the *conservation* and *non-conservation* street sides in relation to *normalised choice R 2500 m* values, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

Each graphs shows on top the street sides falling within and outside conservation areas for the top third of normalised integration 2500 values for the case study area; in the middle: the street sides falling within and outside conservation areas for the middle third of normalised integration 2500 values; and at the bottom, the street sides falling within and outside conservation areas for the lowest third of normalised integration 2500 values.



Islington, London

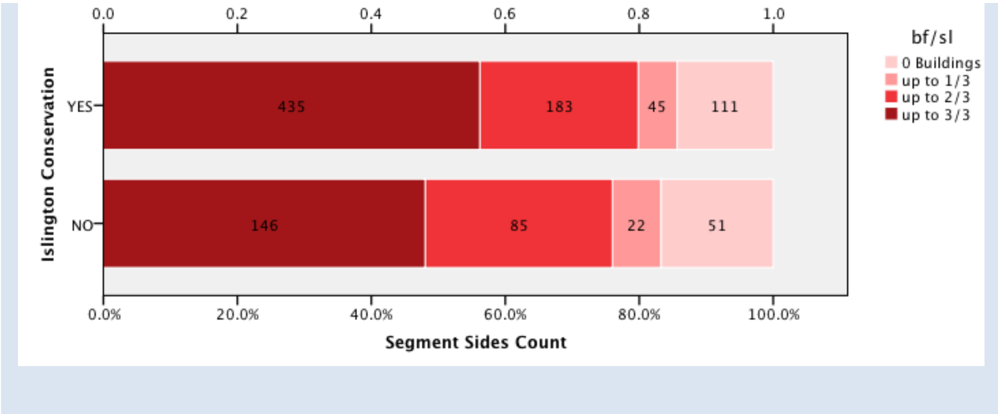


The West Village, Manhattan

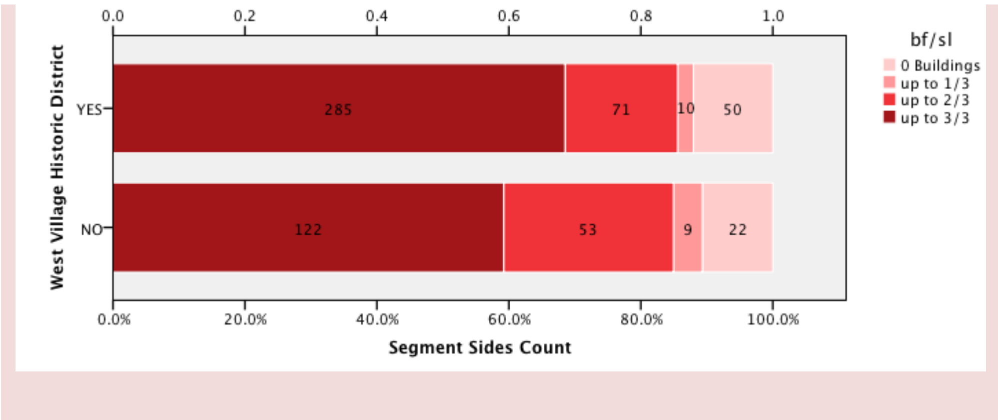
Figure 148. Case studies – the *conservation* and *non-conservation* street sides in relation to *normalised integration R 2500 m* values, with the range of values broken into tertiles: High, Medium and Low.

Showing Islington (top) and the West Village (below).

Given the associations between architectural morphology and street interface already highlighted, it comes as no surprise that the higher presence of historical row housing within the protected areas is translated into a higher frequency of thresholds and a denser street interface overall (see Figures 149-151). Notably, high frequency in primary building entrances – an indication of more public block fronts – is substantially more significant in protected Historic Districts than in street sections with newer buildings.



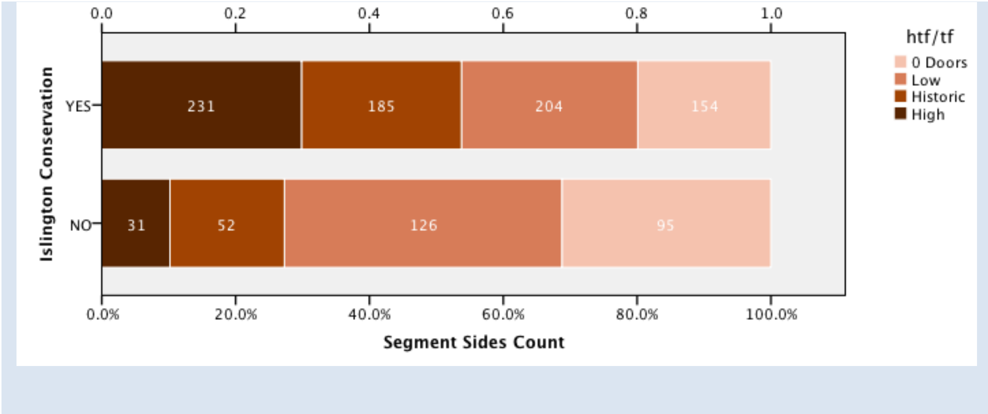
Islington, London



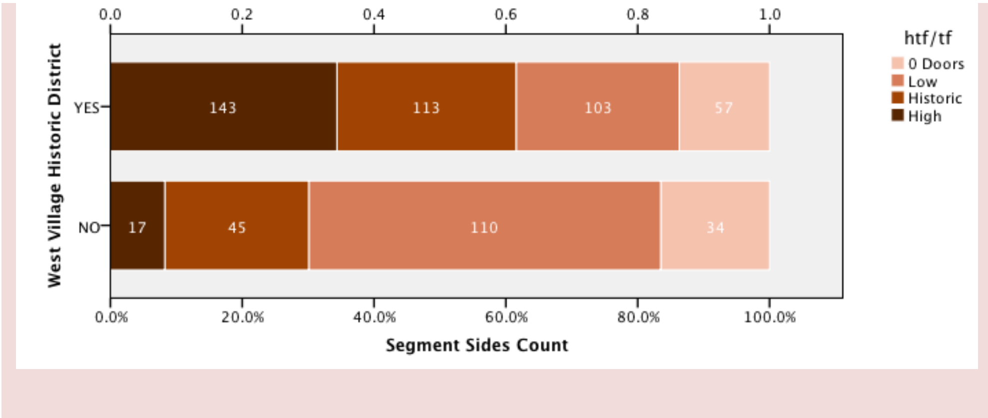
The West Village, Manhattan

Figure 149. Case studies – the *block front / segment length distribution* in *conservation* (top bar on graphs) and *non-conservation* areas.

Showing Islington (top) and the West Village (below).



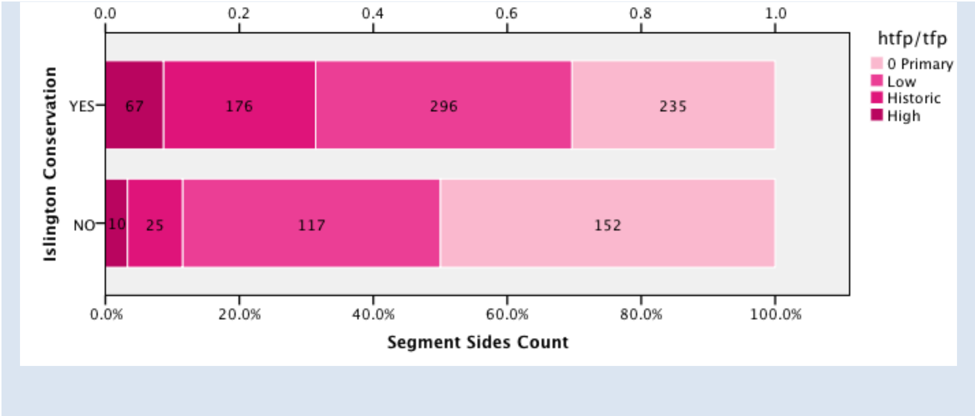
Islington, London



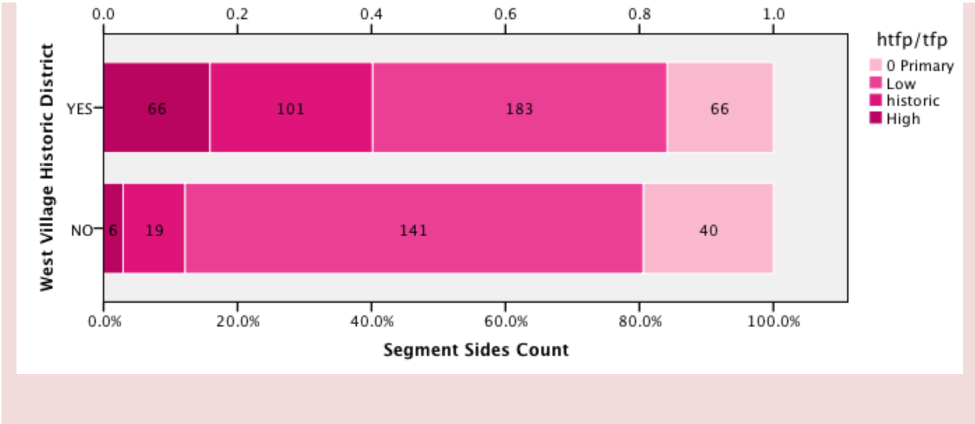
The West Village, Manhattan

Figure 150. Case studies – the *historical / current threshold frequency distribution* in *conservation* (top bar on graphs) and *non-conservation* areas.

Showing Islington (top) and the West Village (below).



Islington, London

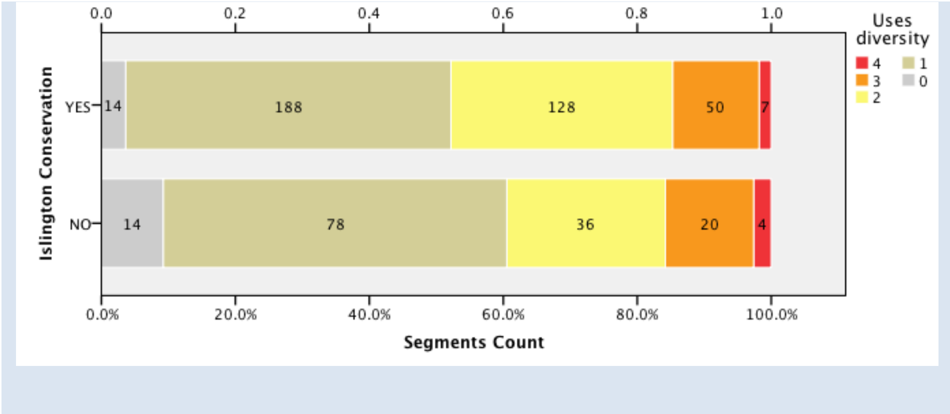


The West Village, Manhattan

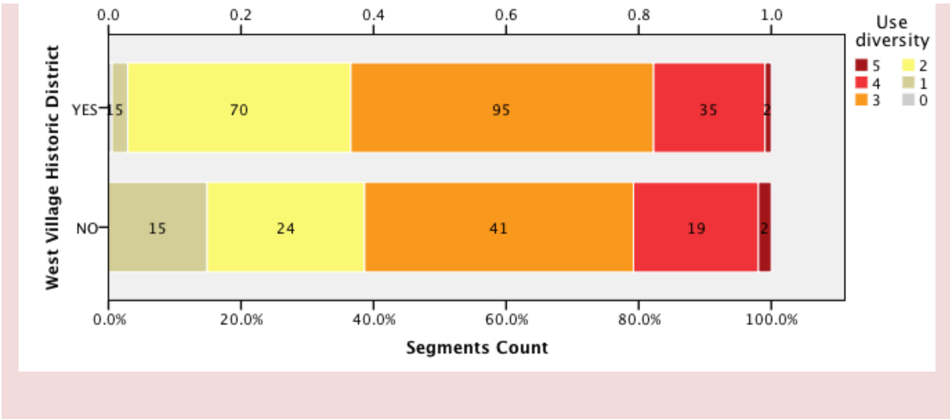
Figure 151. Case studies – the *historical / current frequency of direct thresholds distribution* in *conservation* (top bar on graphs) and *non-conservation* areas.

Showing Islington (top) and the West Village (below).

The relatively equal spread in functional diversity in both cases (Figure 152) confirms that the utility and purpose of the historical building context has changed and adapted over time to fulfil new functional requirements: the once predominately domestic settings of terraced and row houses are now found to support a diverse range of uses in close proximity. Functional mixing at the building scale is another feature discussed in previous chapters, along with the high flexibility, both in layout and façade organisation, which terraced houses and row houses have displayed over time. This study's previous chapters have discussed in greater detail the adaptability of the type, with the terraced houses of Chapel Street and the 'reborn' row houses in the West Village providing examples of the way these buildings have responded to change.



Islington, London



The West Village, Manhattan

Figure 152. Case studies – the *functional mixing* in *conservation* (top bar on graphs) and *non-conservation* areas.

Showing Islington (top) and the West Village (below).

Finally, two points from the conservation guidelines as described for Islington and the West Village were highlighted:

- the special *character* of an urban area is not just the product of its architecture, but of its historical spatial and physical qualities and the socio-economic micro-relations that these support (from the conservation report in Islington). Karimi (1999; 2000) has highlighted the need for conservation policies to acknowledge the *'spatial spirit'* of urban places, and to aim to safeguard urban integrity through the protection of the spatial organisation overall, and not just individual buildings or sites;

- the acknowledgement of the *parts* and *whole* relation in the morphological processes of city building: namely, the consideration that the building unit is a city component which contributes to the physical integrity of its immediate surroundings (from the Historic District Designation report in the West Village).

7.5. Urban interfaces

The discussion in this chapter leads us back to the ideas, outlined in Chapter 3, which justified the selection of the particular case studies. Islington and the West Village were selected for their architecture of row housing and their contrasting grids. While the building type presents cross-cultural consistencies, the probabilistic aspects of the building morphology have been in each case informed by the cultural domain of each city's structure, London and Manhattan.

In London, a spatial hierarchy at the street scale and a morphological unity at the block scale have allowed for the endurance of terraces in their original form and predominately domestic character. In Manhattan, the probabilistic orthogonal grid, along with the potentials for morphological autonomy within the block front, allowed for the emergence of street qualities ranging in morphological and functional profile.

At the same time, in both urban backgrounds the row house has shown high potentials in building-scale adaptability with regards to functional change. The organisational consistencies characteristic of row housing schemes, guiding morphological principles from the building to the block scale, have made it possible for the building type to adapt without disrupting the notional unity of a building with its neighbours. These ordinary buildings act as vital city components, as pieces indispensable to their surrounding wider socio-spatial context.

A crucial aspect of what makes these buildings so well connected to their surroundings is their relationship with the street domain. Throughout its lifespan, the interior of the terraced and row house lies in close proximity to the pavement. The block configuration of narrow plots – and therefore narrow façades – provides a systematic pattern of frequent building thresholds: row housing schemes inherently account for a high density in probabilistic interior-exterior encounters. At the same time, the micromorphology of the building type offers a multitude of potential ways in which the building-street relationship can be configured, re-negotiated and altered, depending on functional and social requirements. Row housing accounts for flexibility and diversity in potential interior-exterior relations, and diversity, and density, are fundamental properties of the micromorphology of the virtual community.

Finally, the effect of the wider street network on the profile of an individual street has been discussed: the grid distributes movement patterns and obliges the co-existence of users; these in turn influence allocations of land use and levels of pedestrian traffic. These features also have an impact on the morphology of the building-street connection; namely, the street network has both a direct effect on the liveability of the street (via ‘natural movement’) and an indirect effect on the morphology of the interior-exterior transition.

Overall, it can be seen that the building-street interface is the morphological unit where all urban components (building, plot, street) overlap, work together and interact.

This chapter closes the analytical research delivered by this thesis. Chapter 8 that follows is the final piece of the thesis. The account will resume the main outcomes from the study of the micromorphology of the London terraced houses in Islington and the Manhattan row houses in the West Village. These outcomes will be discussed in relation to the theoretical ideas that this thesis reflects on and advances: the *virtual community* and the *probabilistic built forms*.

8

Chapter eight - Discussion - crossing 'thresholds' in city building

This research visited the urban settings of Islington and the West Village in order to examine how and why the historical building cultures of terraced houses and row houses have over time sustained diverse qualities of local life, from domestic to urban, in contrasting city structures. The research focused on the one hand on the ways in which building morphology and street network shape street activity, and on the other hand on the interplay of buildings and streets in shaping the city form. In approaching these questions, the study suggested that, besides the syntax of the spatial configuration, an understanding of the syntactical description of potential building-street encounters is a crucial parameter that needs to be explored - but is currently poorly understood. The theoretical origins of this proposition were extensively discussed in Chapter 2, along with a spatially centred definition of the potentially ambiguous notion of building-street interfaces (Peponis, 2012). The theoretical conclusions suggested the need for a configurational study of the micromorphology of the street interface which fundamentally contributes to the formation of the virtual community. A methodological approach for analysing the streetscape in terms of interior-exterior encounters was suggested in Chapter 4, introducing measures which capture properties of the street interface. The methodology combined urban configurational and morphological approaches. Analysis was then applied to the contrasting grids of Islington (Chapter 5) and the West Village (Chapter 6), providing insights on terraced house and row house street micromorphology and on the way the street network has affected the manner of change or continuity seen in the building type over time in each case (Chapter 7).

This chapter resumes the main issues addressed in this work, while aiming to formulate a reflective discussion on the outcomes and theoretical contribution gained with regards to two aspects of city building: built form potentials for (a) *a dense and diverse micromorphology* (namely for generating encounter probabilities configurationally) and for (b) responding to urban change or socio-economic change (namely, for generating morphological probabilities).

8.1. Scope, review and interpretation

This thesis was put forward as an intention to investigate the formation of the urban streetscape over time. The drive has been the effort to decode those aspects of city building which potentially describe the spatial characteristics of what one could consider a 'sociable street interface'. The scope of the explorations was primarily morphological; that is, the study looked at the way street liveability can be supported and/or generated by generic morphological principles of the built form. The aim was to inform urban design by addressing the very elementary stages of the design process: those that impose the morphological rules underpinning built form.

To trace back the origins of this research as discussed in the first chapter, we can recall the reasons for selecting the two building types examined and reviewed in this study. From domestic and modest, to mixed-use and urban, the London terraced house and the Manhattan row house have been formative agents of diverse streetscape qualities. Building morphologies such as the terraced house and the row house represent examples of ‘healthy building’ cultures which sustain and nourish local urban life (Davis, 2006; 2009). Comparing this ‘ordinary’ architecture, modest yet full of life, to contemporary architecture which aspires to social purpose yet which however fails to reproduce urban liveability, the question that arises is whether the morphological characteristics of these modest building types are in themselves an explanation for their longevity. The study visited Islington in London and the West Village in Manhattan to explore the two historical building types in terms of the way their micromorphology shapes street activity and of the way their urban structure (streets and buildings) have responded to urban change. Both at the configurational level of the virtual community, as well as in terms of the ability to adapt to urban change – these two ordinary urban houses, the London terraced house and the Manhattan row house, are found to operate in time as *probabilistic morphologies*; their longevity, in turn, has created further potential for probabilistic encounters at the street domain by adding to the *street interface density* and *diversity* of these historical urban 'coral reefs'.

Considering the *physical city* as the other side of the *social city* (Hillier and Vaughan, 2007), in which each represents a two-way relationship between space and society, two sets of research inquiries were defined: firstly, the role of built form and street network in shaping street activity; and secondly, the role of built form and street network in shaping patterns of morphological and functional change in the streetscape. While the primary focus of the study was to discuss the way space shapes society so as to inform design, Chapter 3 discussed extensively the way social ideas became embedded in and essentially shaped the spatial patterns of London and Manhattan, from streets to buildings. Also, by studying building interior alterations in the West Village and the evolution of row houses into apartment buildings, shows an example of the way shifting social needs re-define domestic space over time.

8.1.2. The morphological problem: building for the virtual community

The first inquiry addressed the essential problem of defining the elements of building morphology which affect street liveability. This inquiry pointed towards the examination of the formation of Hillier's 'virtual community' as the product of both built form and street domain. Put simply, the virtual community refers to patterns of users' potential encounters and their co-presence in physical space. This consideration is based on the suggestion that for people to develop potential social interaction at the street level, they need to be co-present and co-aware of each other's presence. It was argued that building morphology contributes to these patterns of encounters and co-presence at the street level (namely at the ground floor) via the potential interior-exterior encounters organised by the building-street interface (building-street connections; see the theoretical discussion in Chapter 2).

In order to contribute to our understanding of the way building morphological properties affect the potential interior-exterior encounters, and hence street activity, an examination of the pavement micromorphology was suggested and employed. The aim was to address the issue of street liveability based on quantitative data and an analytical study of the urban streetscape, as proposed by Marshall (2012). This examination included an extensive survey of data starting from within the plot configuration and extending to the block front. In both case study areas, a survey of building thresholds was conducted, producing a detailed mapped record of building-street connections along pavements in the two areas. In order to relate the frequency of building thresholds with morphological properties, the length of each façade was mapped and calculated, along with an indication of the building type (terraced house, council house, row house, tenement etc.). Overall, in the streets of Islington and the West Village, data for 12,895 building thresholds were recorded, in 8,309 façades, providing a valuable data sample for analysis, observations and interpretations. This set of data also allowed a refined reading of these block-street interfaces in terms of their morphological and functional density, and the diversity in their interior-exterior encounters.

This refined reading was based on the proposition of considering the street segment as a composite urban unit; in other words, as the product of the street domain (namely, of street configuration) and of the block fronts facing the street (namely, of built form). To discern differences amongst the varying morphologies of block-street interfaces, the study suggested two measures, both of them related to the organisation of interior-exterior encounters in the pavement configuration. The *block front length / segment length* ratio and the *threshold frequency* were calculated for each street segment side. Relating the results from this analysis to the configurational properties of the street segment, it was possible to explore the potential impact of the street network on the morphological properties of the block fronts. And conversely, relating the doorway count to particular building typologies and morphological properties (such as the width of the building façade and the length of the block front), it was possible to explore the potential impact of the built form on the street activity.

Results from the two areas studied confirmed the contribution of the following factors to the micro-morphology of the virtual community:

- *Direct building-street connections*: In general, the study determined that block fronts with frequent and direct building-street connections strengthen the potentials for more intense street activity, generating an 'urban street interface': a higher frequency in doorways creates greater chances for interior-exterior encounters; direct building-street accessibility implies a proximity of private-public domains. For both case studies, the measure of the *historical threshold frequency / current threshold frequency ratio for primary entrances* showed that block fronts which have developed high densities in direct building-street connections are found predominately in street segments with a higher accessibility potential (namely, higher syntactical values).

- *Functional and morphological diversity*: The study of land uses in both case studies confirmed a relationship between a building's function and its type of interior-exterior transition. A telling observation is that commercial uses were found to be accessed almost exclusively via direct entrances. An observed side effect of the impact of building function on type of transition was that varying uses in proximity increase the potential for a morphological diversity of building thresholds and hence for a diverse pavement micromorphology. The row house block fronts are representative examples of the way functional and morphological mixing contribute to street liveability, with building thresholds articulating dense and varying qualities of probabilistic interior-exterior encounters.

- *Street network properties*: In both Islington and the West Village, street segments with higher accessibility and permeability were more intensely developed, with higher frequencies of building-street connections (whether for all thresholds considered or for primary thresholds only).

- *Urban morphology*: Short blocks, and consequentially short segments, generate higher potentials for accessibility and permeability; respectively, these street segments were found to have greater proportions of non-domestic uses.

- *Building morphology*: In comparison with all building types in each case, terraced and row houses were found to have developed a denser building-street interface over time as well as a greater mixing of uses at the building scale. This finding, that terraced and row houses are significantly more likely to have an intensification of building scale activity, was repeated when a comparison was made between street interface properties in conservation v. non-conservation areas, with the latter having significantly lower proportions of intensified block fronts.

In general, in both study areas street interfaces – in terms of street network, building morphology and function – have been affected both by the city structure and the local context:

- *City-wide structure*: The relationship between street network properties and the allocation of land uses was found to differ across the two cases: a functional distinction between the foreground-background area structures was witnessed in Islington, following the grid properties typically observed in the UK, of a sharp difference between the two types of configuration; on the other hand the West Village was found to have a mixture of uses across a higher proportion of the street segments, following the typical north American ‘democratic’ style orthogonal grid.

- *Local context – Islington*: In Islington, seven conservation areas were examined in terms of street network properties, building types and functions, and building thresholds. Results indicate the variety of factors that have contributed to shaping the street interfaces and character of each area, besides architecture – which is usually the primary focus of conservation (Karimi, 1998). Syntactical values; the proportions of domestic and non-domestic uses; the building façade width; the density of doorways and whether these are direct or indirect connections are all factors which go hand-in-hand in composing varying area profiles. The most notable finding is the correspondence between street network properties and land uses (and respectively, of the proportions of direct and indirect entrances). Angel, Chapel Street and Upper Street North, the three areas in Islington with the highest proportions of commercial uses, present the highest mean values for the *normalised measures of integration and choice* over time. Barnsbury, on the other hand, the area with the highest percentage of domestic uses, presents the lowest mean values in terms of street syntax. At the same time, the areas with the highest percentages of terraced houses (Arlington Sq., Duncan-Colebrooke, Barnsbury and Chapel Market) present the lowest door encounter rates – namely, a denser street interface in doorways on average.

- *Local context – the West Village*: In the case of the West Village, the areas of the Historic District and west waterfront were found to present a different character in terms of street syntax and land uses: the west waterfront shows lower accessibility values – which were found to persist over time – and lower mixing of uses at the segment scale. Moreover, the west waterfront presents larger building footprints today than those in the Historic District, where row houses remain, as well as wider building façades and a street interface sparser in building-street connections. In other words, historical differences in the spatial structure of the two districts were translated into a difference in the built form properties in each case (i.e., building morphology, frequency of doorways and functional mixing), and consequently in differences in the configured street interface and the potential street sociability.

8.1.3. The morphological challenge: building for urban change

The second inquiry referred to the *morphological challenge* of sustaining a lively street interface over time whilst responding to the shifting challenges of urbanisation. This line of inquiry demanded an examination of the way temporal processes impact on the built form and the building-street interface. More particularly, this second research trajectory referred on the one hand to the role of the street network in generating and distributing morphological and functional change within the urban environment, and on the other hand to a reflection on whether the building morphology influences *a priori* the potential for building flexibility in adjusting to these changes.

To explore the role of the street network in temporal built form change, the study compared the past grid configurations with the present street network. For Islington, the street layout study stretched back in time for two time periods (c.1910-1965, c.1965-2013), while for the West Village – where the level of change in buildings and street network was examined in greater detail – street layout was studied for three periods in time (c.1898-1921, c.1921-1955, c.1955-2011). The current built form profile was also compared with information retrieved on the building past of both areas (information from Booth's survey c.1898-9 for the case of Islington, and land use data from Broomley & Co. c.1921 and 1955 for all 130 urban blocks in the West Village). The aim was to inform temporal analysis with quantitative and qualitative data from the urban past of the two cities.

Besides this straightforward temporal analysis, another method was introduced for exploring transformations in the urban street interface. A consideration of the historical built form properties was integrated in the measure of threshold frequency for block fronts. Comparing the typical *historical threshold frequency* with the *current threshold frequency*, the study extracted an estimate of whether block fronts became denser or sparser in doorways over time, or if they maintained similar properties in comparison to a typical terraced house and row house block front. By embedding a morphological parameter of the past streetscape into the reading of the present urban form – in relation to street network temporal analysis, as well as in relation to building typologies – it was possible to retrieve information regarding any generic properties of patterns of urban change in the two case study areas. It was observed that both the nature of the built form and the street network have an impact on urban transformation processes and the street interface as it was reconfigured over time.

Results from the two case study areas confirmed the following patterns of change in the street interface:

- Areas where change has been applied at the block scale, replacing the terraced and row houses, were disproportionately located in streets which were relatively inaccessible, i.e., which were spatially disadvantaged in the past.

- These areas still present today less potential for accessibility, as well as a less dense street interface in terms of probabilistic interior-exterior encounters. The latter is a consequence of the types of buildings that replaced the terraced/row houses, whose morphology failed to maintain the strong relationship with the street domain encouraged by the terraced and row house building cultures.

- Piecemeal transformations of the historical buildings, especially in the case of row houses, led overall to block fronts with a greater density and morphological and functional diversity in building thresholds.

- The potential for piecemeal transformations depends on the building morphologies and the rules of aggregation which initially organise the street interface at the level of the ground floor. The analysis showed that on the one hand the detailed design of early row houses served as a flexible template for organising potentials for change and diversity, whilst on the other hand the design of terraced houses created a rule of uniformity which holds building units together, acting as an almost solid block front.

Overall, this study innovated in providing an intergraded methodology for examining the spatial idiosyncrasies at the micro-scale by treating streets and buildings as the collective product of morphological and temporal processes. Analysis treated the street segment in terms of the street grid itself as well as in relation to the buildings facing the street segment – taking account of attributes such as the block front length, building façade width, frequency and type of building entrances, and each building's socio-economic functions.

The explorations presented in this thesis aimed overall to deal with the uncertainty of holistic approaches[62] in design and research (Kropf, 2001); to overcome the hesitation and test the potentials for expanding our understanding of urban space by crossing 'thresholds'. To recall Eliade's definition of thresholds, these imply the possibility of *passage* between separated domains (Eliade, 1959, p.18, 25). A threshold is a physical and/or notional space between two fields to which it is simultaneously adherent, hence its potential ambiguity. By examining issues related to urban design (Marshall and Çalişkan, 2011), this study addresses the threshold of architectural and urban morphology and tackles the ambiguity of linking the two scales, of linking buildings to streets (Jacobs, 1961; Campbell and Cowan, 2002). By examining issues of urban change, the study addresses the threshold of continuity and change and the ambiguity of decoding the temporal and highly relational complexities of urban phenomena over time (Karimi, 1998, 1999). By examining issues of configuration and morphology, namely of syntactical approaches to urban space on the one hand and historico-geographical and process typological approaches on the other, this study addresses the threshold of interdisciplinary methods from the field of urban morphology in urban studies and research (Davis, 2014).

[62] Kropf writes: 'Holism is all very well, but holism is generally a matter of seeing parts together as a whole, not just saying that there are no parts.' (2001, p.33)

In what follows, reflections on city building elicited by the results of this study are discussed.

8.2. Reflections

8.2.1. The block-street interface as a morphological unit

Following the work of Julienne Hanson, this research aimed to empirically test whether building morphology and building-street interfaces contribute to street liveability. Here the study treated the block-street interface as a morphological unit. This presumes the acknowledgement of two morphological principles in city building: firstly, the acknowledgement of the building-street relationship in general; and secondly, the parts-whole relationship.

The first principle reasons that the design of the building/block scale is not an architectural problem which is cut-off from the street-domain. In urban space 'the architecture of the urban object' refers to cities as the final output of design as much – or perhaps even more – as it refers to buildings themselves (Hillier, 1989); namely, the city structure is fundamentally dependant on the street structure and human activities in the open urban realm (c.f. Jacobs, 1961; Alexander, 1966; Hillier and Hanson, 1984; Campbell and Cowan, 2002; Marshall, 2004; Gehl, 2010). And while streets have been increasingly acknowledged as the most powerful spatial and social entity of urban living, the contemporary architecture of urban buildings still remains largely detached from the concept of street life. In other words, the problem has not only been one of dismissing streets as a formative city element *per se* (a problem which space syntax research extensively addresses); but also of disregarding the way streets relate to buildings, and in turn, the way in which these two city elements form together the street interface. To fail to address the building-street relationship is to essentially misunderstand the street domain.

The second principle emphasises the importance of the block front morphology in city building (c.f. Samuels et al., 1997; Campbell and Cowan, 2002; Firley and Stahl, 2009; Gimbal and Firley, 2011; Dalziel and Qureshi Cortale, 2013; Shayesteh and Steadman, 2013). This refers to the way building-street connections assemble to form a street block interface. For instance, as discussed in the methodological section of this study (Chapter 4) a building façade which takes up a whole block front with a single or very few building entrances creates a different interface from an array of frequent building thresholds along the pavement; similarly, street segment sides with buildings set back from the plot line, leaving the whole block front or parts of it 'uncovered', differ from street sides built up across their whole length. These varying building(s)-street relationships create varying street interfaces and configure differing systems of interior-exterior encounters which contribute to a lesser or greater extent to street activity. In other words, the block front – and respectively the block-street interface – needs to be considered as a morphological unit (comprised either of a single building or of an aggregate of buildings). In turn, this elicits some clear conclusions regarding the block front morphology and the parts-whole relationship; namely, the built form aggregation rules, described as follows.

Two morphological properties which relate to potential interior-exterior encounter patterns are affected by the aggregation rules: *scale*, and *unity*. With regards to scale, when the building aggregation rules are applied at the level of the plot (assuming a block front with an array of plots, such as the terraced housing or row housing block fronts), the plot is the module of the aggregate (Caniggia and Maffei, 1979, 2001) and the block front configuration is the sum of plots and thus of buildings (with at least one entrance). This aggregate resembles the generic settlement configuration described by Hillier (1989), where the settlement is the random outcome of morphological rules applied at the 'elementary cell'[63] (see Figure 153). In general, a higher subdivision of building plots (within feasible constraints regarding the minimum plot width) leads effectively to narrower façades and therefore higher chances for a block-street interface which is dense in potential interior-exterior encounters (assuming at least one entrance per façade). In contrast, when the building aggregation rules are applied at the block scale, and the same building unit extends along the block front length, whilst theoretically a wider range of building entrances might ensue, the reality is, as proven from the data from Islington and the West Village, that wider building façades consistently have a significantly sparser door encounter rate than narrow façades. The significance of this for the urban experience is that pedestrians are likely to walk alongside a solid boundary for a significant proportion of the street segment length and pavements are likely to be populated mainly by pedestrians passing through rather than using the street itself.

[63] Namely, a one-space building cell with an entrance.

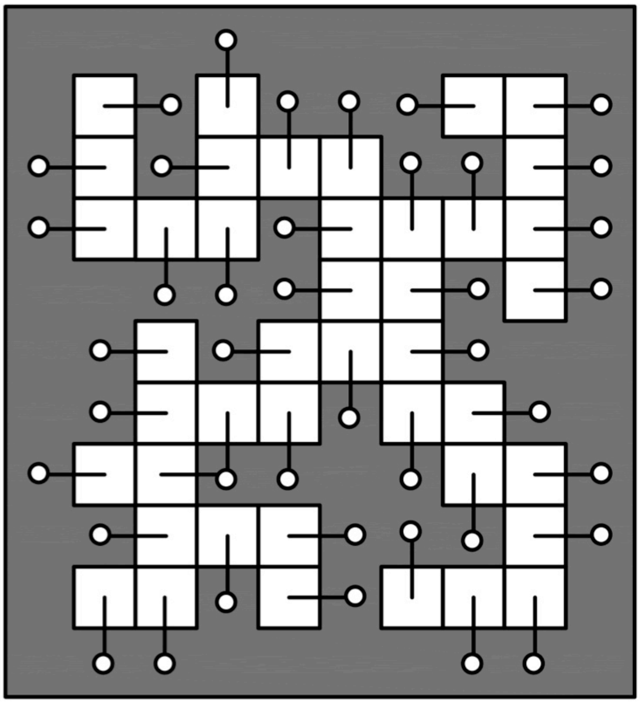


Figure 153. The 'elementary cell' – computer generated settlement simulation.
Redrawn from Hillier (1989, Fig. 4, p.7).

This shift in the scale from plot to block for the modular of the aggregation rules causes as well a shift in the scale of the parts-whole relationship within cities; while in the first case, the parts-whole relationship begins within the block, in the second case the parts-whole relationship applies to the blocks and the city, increasing the scale of the urban space throughout. Overall, block fronts with frequent potential interior-exterior connections maintain references to the 'traditional' settlement patterns by keeping *the scale of the street interface*[64] closer to the human scale and by increasing the chances for street activity to take place. Temporal analysis in the study here also showed that building morphologies which support a pattern of frequent interior-exterior connections are more likely to become denser in doorways over time; namely they increase further the probabilities for building-street interaction and for a sociable street interface to occur.

[64] This does not necessarily mean that the scale of the building volume is or should be close to the scale of a traditional settlement.

Unity is another morphological factor akin to the parts-whole relationship, and which relates to the emergent probabilities within a block front. If we consider a rage of diversity and uniformity (functional and morphological) across a block-street interface, it is understood that unity can underpin this whole range of possibilities. However, in the case that unity is overlaid by uniformity, the block front becomes more solid and closer to the case discussed previously: namely, the case of the block being the modular of the city building aggregate. This applies to block fronts which are configured by one or many buildings. Recall for instance the discussion regarding the unity of the terrace front in comparison to the morphological freedom observed in the Federal row housing schemes: in the first case, the block front preforms as one uniform building unit – even the name 'terrace' implies this – while in the second case unity is simply an organising template for potential diversity[65]. The patterns of change observed for Federal row houses in the West Village appear to confirm this, recording a probabilistic and diverse interface developed over time. Indeed, other row house architectural styles in the West Village, which presented a more uniform block front than the Federal (Greek Revival, Italianate etc.), show greater solidity over time.

These reflections regarding the consideration of the block-street interface as a morphological unit lead to further important points regarding the micromorphology of the virtual community and its effect on street liveability over time. The next section raises these points in order to clarify the suggestion made by this study that specific morphological rules correlate to a sociable and probabilistic street interface.

8.2.2. Urban encounters: probabilistic micromorphology

This section aims to tease out some relevant implications and assumptions which might be translated into misinterpretations in design approaches concerning suggestions made here about the built form sociability. This study suggests that urban design aims towards embracing the two main building morphological properties which potentially strengthen street activity: the *dense* and *morphologically probabilistic* block-street interface. Density here refers to the frequency of probabilistic interior-exterior encounters, and morphological probabilities refer to the potentials for diversity and responsive manner in change (namely, the shift into more or less density and

[65] Of course, building regulations is an important factor which relates to unity, along with ownership which can contribute in strengthening or decomposing uniformity.

diversity over time). Some clarifications are then required regarding the following topics:

Subdivision

In their *Re:Urbanism* manifesto (2002) Campbell and Cowan discuss the role of land subdivision that is neglected by contemporary building practices and policies. Introducing the publication *Making massive small change* (published in 2011) on the context of 'smart urbanism', Campbell writes in an earlier publication (2010, p.4):

> *'All vernacular starts with a plot and its relationship with buildings and streets – something that was achieved very well in the past. Many successful models hinged on the narrow fronted plot, with frontage dimension becoming the key indicator of wealth and social standing. Booth's Plan of London is a map of plot frontages – the narrower the plot frontage, the lower the pecking order (Booth, 1899).'*

It can be said that this assertion contains both truth and aphorism. As extensively discussed, the study here confirms on the one hand that street interfaces configured by narrow plots and building façades present higher frequencies of building thresholds and support functional and morphological diversity across the block front. On the other hand, the study contributes also to clarifying the following: when considering *generic* morphological rules regarding the way built form can enhance street activity, it is understood that the elementary morphological property which affects street activity is that of the street's *virtual encounter field*, namely the presence of a potential relationship in the accessibility – the threshold – between building and street. In this sense, it is understood that the patterns of thresholds are actually independent from the pattern of plots. A dense pattern of narrow plots does indeed offer a higher potential for a high threshold frequency, but this does not negate the fact that a building covering the whole block front can achieve the same frequency of interior-exterior encounters. The fact that the majority of block scale redevelopments so far present lower densities in building-street connections does not predetermine that this norm cannot be overturned. In other words, when looking at the building-street relationship, *subdivision* applies at the level of the ground floor and the many possible 'faces' that the block front can have towards the street domain. That said, the upper floors and the scale of building present different implications, as shall be discussed next.

Height and scale of building

Given that the rule of subdivision applies at the level of the ground floor and relates primarily to the interior-exterior encounters supported by the building form, then it is implicit that the study here cannot analyse any potential impact resulting from the morphological properties of the upper storeys or height of a building. The key findings regarding building scale arising from this study's research can refer only to length: to the street segment length and respectively to the block front length. The analysis in question found that short street segments increase permeability probabilities and enhance the flows of pedestrian movement patterns within the city streets – generating in turn a series of multiplier effects via land use mixing, morphological density and diversity of thresholds. Beyond that, with regards to user encounters at the street level it cannot be asserted that lower-rise small-scale buildings are more efficient than taller ones, unless tested and proven so. For instance, taller buildings have an impact on sunlight reaching the pavement level; the way this might affect street activity is another parameter which indeed relates to building morphology (Steadman, 2014) and could be the inquiry of another study that extends to the organisation of the upper building levels.

Probabilistic built forms

An important point raised by the study with regards to probabilities and the flexibility of the built form in adjusting to requirements for change in use and/or morphology referred to the cross-scale organisational properties of the spatial layout of buildings; namely, to the existence of a template (a modular grid) applied across the building interior and the block subdivision in plots. In turn, the coherent spatial organisation prompted a consistent morphological organisation of the building and block front. This template ensured spatial and morphological unity (not to be confused here with uniformity – as *unity* allows for individual row house *architectural variabilit*y whilst implying larger scale unity) and scalar modifications, from larger to smaller and vice versa. Here, again, the emphasis for design approaches is not on the existence of the template itself, but on the outcome, which is the ability to apply a 'fit-for-purpose' change whatever the scale of design or transformation.

Another factor relating probabilistic spatial layouts with building forms is implied by the fact that looking at the micromorphology of the virtual community and the potential interior-exterior encounters takes us back to a generic and fundamental rule of built form organisation: that of maintaining a regular and frequent potential connection between buildings and streets when designing urban forms. This very simple rule was formulated by Hillier and his notional computer-generated settlement patterns in 'The architecture of the urban object' (reproduced here in Figure 153) (1989; see earlier in Hillier and Hanson, 1984, p.198-222). Notably, Hiller points out that the fewer the rules applied for the random computer-generation process, the higher the emergent probabilities; and respectively, when more rules are applied, a greater number of building units is then required to increase emerging probabilities. This observation, tested by computer-generated patterns, is also picked up by Campbell, who notes that *'limited choice equals infinite possibilities'* (2011, p.4).

Order and structure

The final observation returns to Hanson's insights regarding the notions of order and structure (1989) and the author's later propositions in 'Urban Transformations: a history of design ideas' (2000). In the latter study, Hanson compares the properties of the historical built form with modernist redevelopments in Somers Town, London, and raises implications for the way the built form structures the three-dimensional streetscape. Hanson proposes eight descriptors for analysing the properties of built volume, amongst which the following are mentioned (*ibid.*, p.100):

- outward/inward facing morphology;
- density maximising/minimising morphology;
- organic/geometric morphology;
- flexibility in/resistance to change.[66]

Relating the concepts of order (apparent, visible organisation) and structure (intrinsic organisation) with observations and implications discussed here earlier regarding the patterns of interior-exterior encounters, it is conjectured that the four properties mentioned above by Hanson refer to the structure of the street interface and not its visible order (see for instance the random computer-generated variations in Hillier's article[67] - see a reproduction in Figure 154). However, there is an important point that needs to be clarified about the organic/geometric morphology concept. Manhattan is an example of 'top-down' approach in design and a highly geometric urban system.

[66] The remaining four properties mentioned by Hanson are: continuous/fragmented street space; direct/indirect interface; instrumental/expressive space; and space of social production/re-production. (Hanson, 2000, p.100).

[67] Figures 5 and 6 in Hillier's article (1989, p.7) show examples of geometric and non-geometric configurations generated by the same morphological rules.

Yet, we have seen in this study that Manhattan has maintained a probabilistic configuration throughout, across street layout and built form, and therefore the assumption that probabilities can emerge only in 'bottom up', randomly growing systems becomes questionable. Therefore, it is important to clarify that the characterisation of 'top-down' and 'bottom-up' should refer to *the structure of design and not its apparent order* (both with regards to the logic of the design approach and the shape/geometry and performance of the design product). Additionally, regarding the 'top-down' characterisation, a fine difference should be noted: the disregard of the parts-whole relationship is irrelevant to whether the structure and growth of the whole predominates and guides the structure and growth of the parts or not. In this sense, a 'top-down' approach is not the same as the type of approach which dismisses or misunderstands the nature of the parts-whole constant interaction and relations of interdependency. Simply put, we cannot assert that a 'top-down' morphology cannot work probabilistically (or 'bottom-up') over time; however, learning from the two case studies here, what can be asserted is that 'top down' and 'bottom up' contextual fragmentation is not helpful when referring to historical morphological processes.

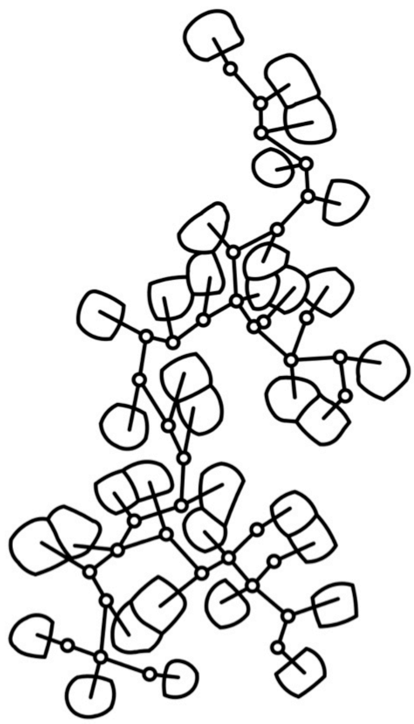


Figure 154. The 'elementary cell' – 'de-geometrised' computer generated settlement.
Redrawn from Hillier (1989, Fig. 4, p.7).

These clarifications put forward in this section have been made to highlight that the specific call for architects and urban designers addressed by this particular study is to find a way to connect city elements and have them work together probabilistically (Hanson and Hillier, 1989). In this spirit, an important design aim in city building might be to turn building thresholds into active areas of interior-exterior connections and not just ambiguous inert locations surrounding building outlines.

A final note on lessons gained from the two case study areas refers to the conservation of historical ordinary building complexes in the urban realm.

8.2.3. A note on conservation

Street sections with a high presence of terraced houses in Islington and row houses in the West Village came under the aegis of urban conservation in 1969, halting, or overturning, the impacts of urbanisation upon the historical building stock. The areas of Islington and the West Village offered therefore an opportunity to assess the outcome of conservation policies: what street interface qualities were maintained over time in the conservation districts that may have been lost in those areas that were not protected? In general, conservation districts in both areas present a denser and more diverse – functionally and morphologically speaking – street interface. While the gains of conservation are obvious, since conservation blocks remain *probabilistic* in their interface with the street, the point raised here will refer not to the policy of conservation *per se*[68]; rather, it is important to highlight that buildings outside those protected historical areas largely present a less connected relationship with the street. In other words, new developments have significantly failed to produce a space of frequent potential interior-exterior encounters and an open interface towards street life. It is conjectured that the difference between conservation principles and regular design practices lies essentially at the latters' disregard of the particular spatial and physical context of the area under design and its surroundings. Embedding the concept of 'spatial spirit'[69] in conservation processes, Karimi (1998, p.326) suggested that:

> *'…before engaging in any detailed process of conservation, a basic knowledge of the spatial harmony between the past and present is needed, otherwise the past loses its logic, and consequently its viability to be conserved, or the new cannot find its appropriate place to function.'*

In Karimi's words there is an inherent consideration of the past, present and future as a continuous string of urban processes. In this sense, this suggestion can and should be extended to every action behind city building, regardless of whether it is part of a conservation process or not. Moreover, it is suggested here, that besides the spatial syntax of an urban system, the pattern of building-street connections, namely the syntax of potential building-street encounters, needs to be closely examined prior to

[68] This is because conservation policies in the two areas these have not been studied extensively in terms of the regulations applied; however, several important points related to urban design principles were discussed in the relevant chapters (Chapter 5B; Chapter 6B).

[69] By 'spatial spirit' Karimi means a 'fundamental spatial pattern […] which constructs the essence of each urban genotype.' (1998, p.273)

intervening in the street activity of any place, since essentially any urban design act should be considered as an act on street life.

With this suggestion for a constant consideration of the past, when designing the future form of an urban space, the discussion moves on to the next and final section which brings together some closing ideas and inspirations emerging from this research.

8.3. Patterns of urban change - tackling urban rhythms

8.3.1. Spectres of the future

Overall, this research has been an attempt to understand the way design can tackle the growing complexity of *urban rhythms*. In this thesis closure the notion of rhythm is employed – more in the sense of a trigger for the architectural imagination to face the uncertainty and spectres of the future, rather than a rigid theoretical metaphor *per se*. Lefebvre argues:

'Everywhere where there is interaction between a place, a time and an expenditure of energy, there is rhythm.' (Lefebvre, 1992; 2004, English trans., p.15)

Reading these words by Lefebvre, street life can be visualised as having its own rhythm. As Lefebvre would picture it, this urban rhythm – or 'choreography'[70] as Peponis would call it (1997) – of street life can be seen as the outcome of the *interaction* between the built environment, time and people; or in other words, the outcome of the interaction between *physical*, *temporal* and *social* rhythms. This notion of rhythmical exchange between physical space (as the aggregate of buildings and streets) and street life, at a time situated within a temporal continuum of urban past and present, can capture the study's world view and contextualise what has been discussed so far. It was the aim of this study to recall space syntax theory propositions which suggest that *both buildings and streets* are not just a background to the rhythms of urban life (Hillier, 1989, Hillier, 1996; Hanson, 2000); and to glean

[70] With 'choreo-' standing for the Greek word *χώρος* (namely 'chóros', meaning 'space' in English) instead of *χορός* (namely 'chorós', meaning 'dance' in English).

any potential insights into the way building morphology can enliven this choreography. In this sense, the street interface organises a *rhythm of building-street encounters* and it is up to the architect and urban designer to create a composition of encounters which is in rhythm with its surroundings and with that of the wider city's 'spatial spirit' (Karimi, 1998).

8.3.2. …In theory and research

Tackling urban rhythms in theory has been essentially a morphological problem for the scope of this research explored in a syntactical manner. The most important contribution in this sense was the assertion that a reading of the streetscape based on the theoretical framework of space syntax, which unravels the generic relations between space and society, can inform our understanding of the morphological properties actively shaping street activity. On the other hand, a morphological understanding of the building aggregation rules can enhance our appreciation of the way buildings respond to patterns of change imposed by the configuration of the grid.

There are many potential research streams which emerge from or can be informed by this topic of emphasising the building-street relationship. To name a few: an investigation of the street interface micromorphology including in this instance visibility relationships between building interior and exterior; an investigation of how these visibility relationships change depending on the building function and the element of privacy; an extensive investigation of functional and morphological diversity patterns in street interfaces (looking, for instance, at whether a mixing of buildings of varying age accounts for morphological diversity and improved liveability – as Jacobs suggests and as this study has indicated); an extensive research on building/block-street interface changeability (see e.g. Törmä, 2014); research on the cognitive implications of the street interface for street activity (see Emo et al., 2012).

The common ground for all such future research inquiries which would enhance our understanding – theoretical and practical – of the complexities of urban rhythms is the potential for, and the necessity of, an interdisciplinary (and/or intradisciplinary) approach to in addressing urban space (Davis, 2014).

8.3.3. …In practice

In the closure of Chapter 2, Karl Kropf's words (Kropf, 2001, p.39) addressing challenging questions regarding emergence and the field of probabilities in urban space and design were repeated to accompany the reader as background thoughts while traveling through the thesis. It was the effort of this study to strip the built form from aesthetical, formalistic or geometrical fixations, and to explore the very generic syntactical properties which link buildings to streets. Using the properties of this generic building-street relation as an elementary morphological rule with which to begin design experimentation (such as building-street interface density) opens the way for probabilities in the design of the built form.

On the other hand, passing from the field of probable or experimental to the field of urban reality, tackling rhythms in practice (either through design or through regulations and policies) means understanding the intrinsic logic of spatial and physical patterns. McCormac (1996, p.3) argues that *'functions of a very different type can co-exist successfully if they are in the right place; it is not a question of architectural style, but of purpose and use, and of scale and symmetry across places.'* In other words, McCormac renders the consideration of spatial, physical and functional relations – or rhythms - amongst city areas as the guidelines for design.

Figure 155. The West Village, Manhattan – Waverly Pl. and Grove St. (c.2011)

8.4. Conclusions – Building cultures: Vision and perspective in the architecture of the everyday

London and Manhattan constitute extraordinary urban configurations. This thesis explored aspects of the building culture of the two urban settings which laid the foundations of their architectural and urban morphology by focusing on two urban areas: Islington and the West Village. The study was occupied with the architecture of the everyday: the ordinary buildings, the streets and sidewalks. Overall, both programme and emergence have shaped London and Manhattan throughout their spatial histories. The study integrated space syntax and morphological approaches, developing a high-resolution configurational reading of the street interface micromorphology. The analytical methods were applied to the *building*, the *block* and the *city scales*, emphasising above all the probabilistic encounter field of the building-street relationship.

Learning from the terraced and row house building cultures, this thesis aimed to form a contribution towards understanding the problem of the micro morphological complexities and encounter probabilities that these historical ordinary building cultures manage to sustain; the study found that for both London and Manhattan there exist inherent cross-scale organisational consistencies that hold the urban elements together, whilst enabling the changes that allow urban adaptability and growth. Analysis looked at the buildings' aggregation rules in the London terraced house and the Manhattan row house schemes; and on the other hand, at the structure of the urban grid in each case. The aim was to shed light on the interplay of the urban grid and the built form, underlining the challenge for any urban design approach: to tackle both along the lines of a unifying and diachronic spatial logic.

This thesis stood between buildings and streets, at the interface of architectural and urban morphology, in order to examine the architecture of the everyday. Emphasising the importance of the street interface micromorphology in urban life, the study aspired to show that, for urban design, a good place to restart is to reconcile the dynamics and potentials of buildings and streets, and to contemplate once again the visions of the past when building cultures did not forget that architecture within the city was *about* and *for* the city. Keeping the building-street relation integrated into design perspectives is the first threshold for architecture to cross towards the city domain.

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Appendix

A1. Space syntax measures

TABLE A1 Space syntax measures	**Formula**
Combined integration and choice	(*Node Count*/*Mean Depth*)*(log(*Choice*+2))
Normalised integration (NAIN)	value (“T1024 Node Count”) ^ 1.2 / (value (“T1024 Total Depth”) + 2)
Normalised choice (NACH)	log(value (“T1024 Choice”) + 1) / log(value (“T1024 Total Depth”) + 3)

Table A1. Space syntax measures: formulas.

A2. Mapping data: building façades

A2.1. Islington, London

Figure A2.1. Islington, London – building façades: lines and points. (c.2013)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

A2.2. The West Village, Manhattan

Figure A2.2. The West Village, Manhattan – building façades: lines and points. (c.2011)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

A3. Mapping data: street segment sides

A3.1. Islington, London

Figure A3.1.1. Islington, London – building façades as points: street segment *side one* and *two*. (c.2013)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

Figure A3.1.2. Islington, London – building thresholds as points: street segment *side one* and *two*. (c.2013)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

A3.2. The West Village, Manhattan

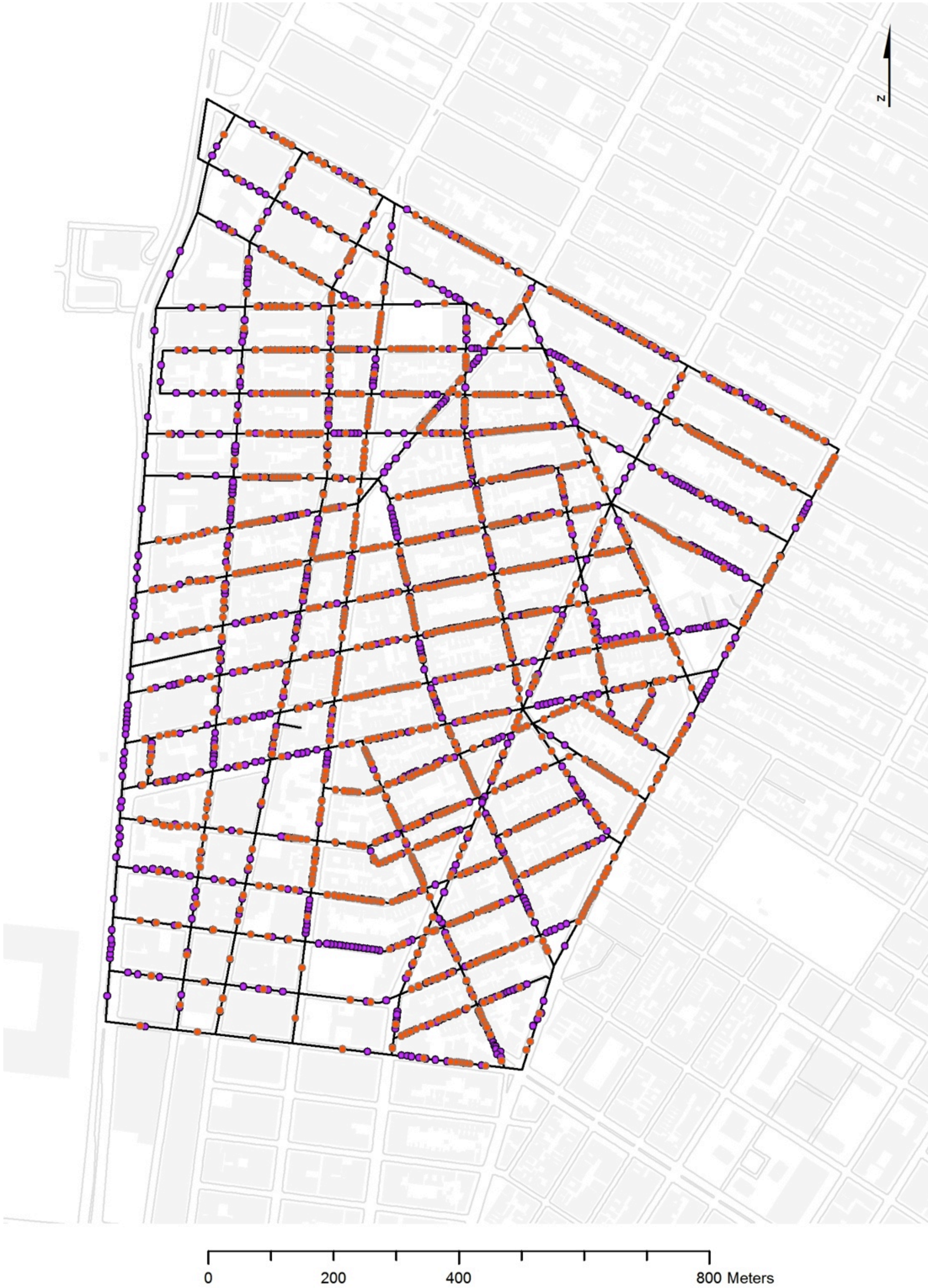

Figure A3.2.1. The West Village, Manhattan – building façades as points: street segment *side one* and *two*. (c.2011)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

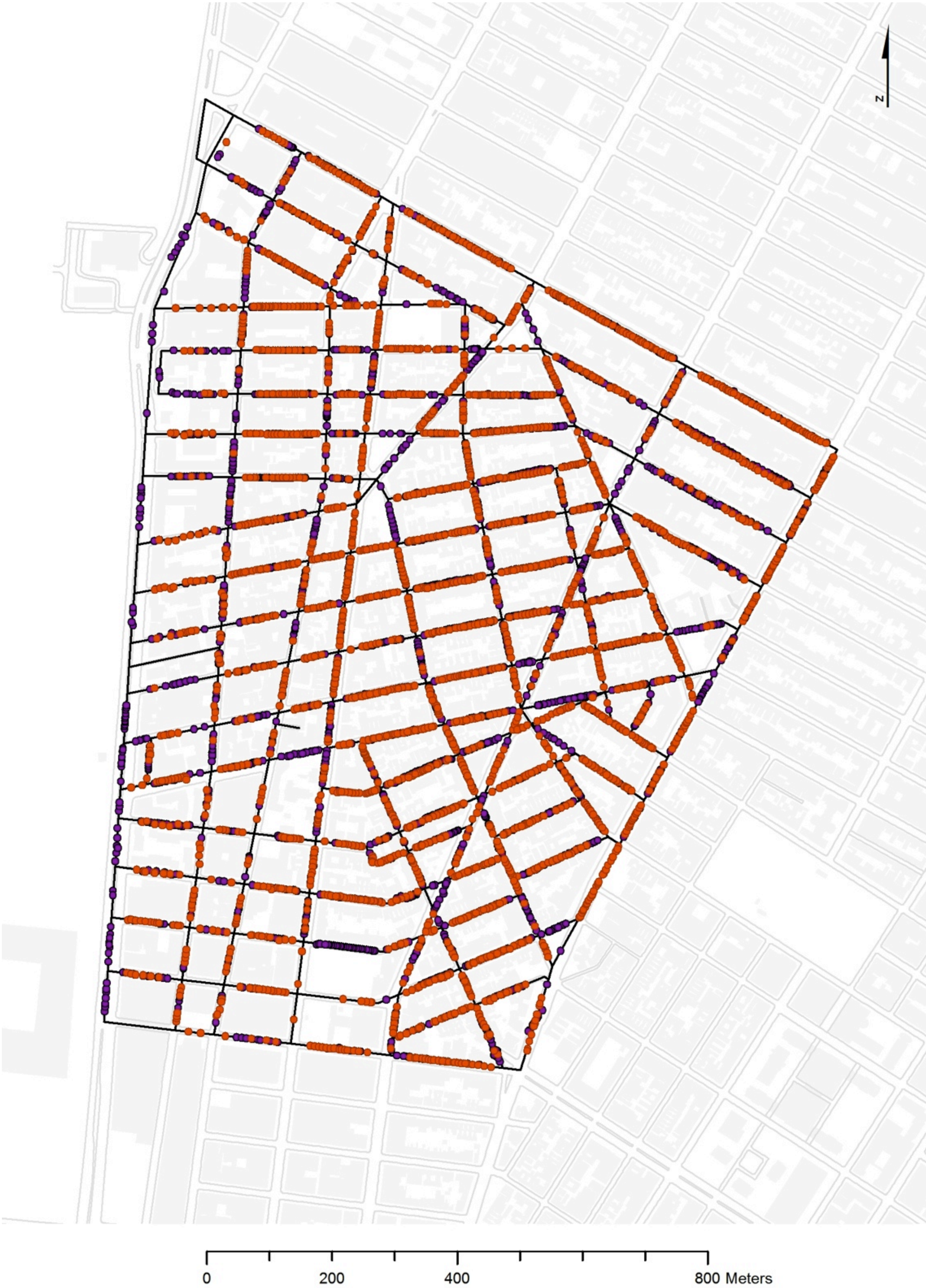

Figure A3.2.2. The West Village, Manhattan – building thresholds as points: street segment *side one* and *two*. (c.2011)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

A4. Chapel Street – *Post Office Commercial and Professional Directories* c.1852, 1895 and 1915

Building No	1852	1895	1915
1	-	Lutteridge Charles Henry, greengrocer (p.1207)	-
2	Hawkins George, furniture broker (p.784)	Wall Charlotte Ann (Mrs.), baker (p.1493)	Werner William, baker (p.1314)
2 A	-	-	Ciotti Angelo, confectionter (p.814)
3	Cooksley John, slater (p.677)	-	Reynolds & Mundy, butchers (p.1181)
4	-	Benjamin Solomon, miscellaneous dealer (p.819)	Benjamin Solomon, linendraper (p.743)
5	-	Hussey Thomas, paperhanger (p.1124)	-
7	Oseman William, bricklayer (p.910)	-	-
8	-	Konskier Nathan, job draper (p.1167)	Sandow Ryman, milliner (p.1208)
10	Robinson George, prof. of music (p.956)	Phillips Loo, wardrobe dealer (p.1311)	Reynolds & Mundy, butchers (p.1181)
11	Heath Francis, coach painter (p.787)	-	Morgan Timothy, provision merchant (p.1103)
12	-	West George, wardrobe dealer (p.1512)	West Rebecca (Mrs.), wardrobe dealer (p.1316)
13	-	-	Kilby Grace (Mrs.), corset maker (p.1023)
14	-	Frayling George Augustus, milliner (p.1017)	Davies Alfred William, cheesemonger (p.852)
15	-	-	Wiles Margaret (Mrs.), wardrobe dlr. (p.1325)
17	-	-	Finer Max, linendraper (p.898)
18	-	-	Sanders Bros. corn mers. (p.1208)
19	-	-	Lawrence Stephen Charles, pawnbro-ker (p.1038)
20	-	Odell George, greengrocer (p.1282)	Hancock Albert Charles, herbalist (p.952)
21	-	-	Stokes Mary Elizabeth (Mrs.), butcher (p.1257)
22	-	Marchant George, tobacconist (p.1220)	Sinevitz Moss, cloth cap dealer (p.1230)
23	-	Tromer Bertha (Mrs.), draper (p.1472)	-
24	-	Hayden Hannah (Mrs.), china & glass dlr. (p.1085)	-
25	-	Parrish George, miscellaneous dealer (p.1295)	
26	-	Stellwagen Philip, butcher (p.1433)	Lustig Ralph, butcher (p.1064)
27	Street John, zinc & tinplate worker (p.1010)	Cohnreich Emil, bootmaker (p.909)	-
28	-	Ware Frederick Thomas, cheesemon-ger (p.1498)	-
29	-	Swift Richard, fruiterer & greengrocer (p.1447)	Simpson & Co. corn dealers (p.1229)
30	Morris Robert, baker (p.892)	Jager George, baker (p.1135)	-
31	Bignall John, grocer (p.616)	-	-
32	-	Collier Edwin Chas. beer retailer (p.912)	Blumenthal Philip, costume maker (p.761)
33	-	Toplis Erlward, bootmaker (p.1467)	Taylor Charles Henry, bootmaker (p.1269)

34	-	-	Brading Minnie Gertrude (Mrs.), eel pie house (p.770)
35	Dauiel Thomas, fruiterer (p.692)	Walker Thomas, eel pie house (p.1493)	-
36	-	Hitchcock Charles Joseph, fishmngr. (p.1102)	Hitchcock Charles Joseph, fishmngr. (p.977)
37	Gibbs Robert Wm., gasfitter (p.750)	Wood Joseph, greengrocer (p.1539)	-
38	-	Tyler Henry Peter, bootmaker (p.1478)	-
39	Bottom Jose ph, butcher (p.625)	Ginnings Henry Chas. earthenware dealer (p.1036)	-
42	Hooker Peter, confectioner (p.802)	George Harry, butcher (p.1120)	Pearse Frederick William George, china & glass dealer (p.1145)
42 A	Harrow William, tailor (p.780)		
43	Warner Hannah (Mrs.), bookseller (p.1048)	Burnage William, confectioner (p.869)	Pearse Frederick William George, confectioner (p.1145)
43 $^{1/2}$	Davis Mary (Mrs.), cooper (p.696)	-	-
44	Penny Henry, bootmaker (p.922)	-	-
46	Rowton Robert Ivitt, grocer, (p.962)	Kennett Henry, grocer (p.1157)	-
47	Durman Charles, fishmonger (p.712)		
49	-	-	Mence George, pawnbroker, salesman & jeweller (p.1089)
50	-	-	Allwright Arth. butcher. (p.714)
51	White Wm. cheesemonger (p.1061)	-	-
52	-	Rubery Henry, linendraper (p.1367)	Paskin Harris, boot & shoe dealer (p.1141)
53	-	Horden Wm. Henry, linendraper,4g (p.1112)	Maypole Dairy Co. Ltd. butter, provision & tea merchants (wholesale and retail) (p.1086)
54	-	Horden Wm. Henry, linendraper,4g (p.1112)	Wallis & Co. mantle makers (p.1302)
55	-	Goedecke Henrietta (Mrs.), baker (p.1040)	Popular Creameries Ltd. provision merchants (p.1160)
56	-	Hermann Hyman, baker & confectioner (p.1093)	Taglicht Rose (Mrs.), furrier (p.1265)
57	Ward Joseph, shoemaker (p.1047)	Green Henry & Co. grocers (p.1051)	-
59	-	Tollervy Rosetta (Mrs.), butcher (p.1466)	Crowley George Alfred, butcher (p.844)
60	-	Cohen Issak, hosier (p.909)	-
61	-	Gihberd John, retail bootmaker (p.1032)	Gibberd John Ltd. Bootmakers (p.922)
62	Wilson James, Chapel House P.H. (p.1070)	-	-
63	-	Finden George, dining rooms (p.1003)	Finden Frances (Mrs.), dining rooms (p.898)
64	Booth George, carpenter (p.624)	Conner Charles, fishmonger (p.916)	Conner Charles, fishmonger (p.829)
65	-	Liell Damien, baker (p.1189)	Liell Damian, baker (p.1049)
66	Berridge Richard, bootmaker (p.614)	Paling Eliza (Mrs.), ladies' outfitter (p.1291)	-
67	Searle Henry, tailor (p.975)	Lustig Raphael, butcher (p.1207)	-
68	-	Evans John Bowen, linendraper (p.992)	-
69	Clayton Edwd. lamp shade manfr (p.666)	Conway Samuel, butcher (p.918)	-
70	Sasse Claude P. mother o'pearl ma. (p.970)	Sainsbury John, provision merchant (p.1403)	-

71	Goddard Edmund, ham k tongue dealer (p.754)	Rapson Frederick, grocer (p.1337)	-
72	-	Hardwick Richard, shoemaker (p.1072)	Nathan Harry, hosier (p.1113)
73	-	King Louisa (Miss), milliner (p.1162)	Lickerman Mark, ladies' tailor (p.1049)
74	Butler Wm. surgeon, Chapel street (p.647)	Layton Frederick James, fried fish shop (p.1178)	
75	-	Darvell Edward (p.944)	Narotzky Samuel, gramophone dealer (p.1112)
77	Tasker Joseph, cheesemonger (p. 1016)	Steer Geo. oilman (p.1432)	-
78	-	Ventris Alfred Matthew, beer retailer (p.1485)	Cawthorne William, beer retailer (p.804)
79	-	Wienberg, Batty & Co. milliners (p.1523)	Piper Reuben William, tripe dresser (p.1156)
80	Tower John Geo. upholsterer (p.1029)	Ball Fredk. Chas. furniture dealer (p.799)	Baldwin Henry John china & glass dlr. (p.733)
81	-	Taylor Alfred, wardrobe dealer (p.1452)	Conway Edward, butcher (p.831)
82	-	Richards Thomas, furniture dealer (p.1348)	Dinnis George, cheesemonger (p.863)
83	-	Richards Thomas, furniture dealer (p.1348)	-
84	-	Edwards Alfred, herbalist (p.980)	Cohen Henry, boot dealer (p.823)
85	-	Abrahams Matilda (Mrs.), miscella-neous dlr. (p.767)	Goldsmith Abraham, wardrobe dealer (p.929)
86	Yamold, Philip, tailor (p.1081)	Harrington Edward, confectioner (p.1074)	Goldsmith Abraham, clothier (p.929)
87	-	-	Goldsmith Abraham, furrier (p.929)
88	-	Wells Edward, miscellaneous dealer (p.1509)	Rosenfeldt Lewis, hatter (p.1193)
90	-	Owen Agnes (Mrs.), wardrobe dealer (p.1287)	Hussey Thomas, paperhanger (p.993)
91	-	Swales Charlotte (Mrs.), baker (p.1446)	Sinevitz Moss, cloth cap dealer (p.1230)
92	-	Canner Rose (Mrs.), wardrobe dealer (p.916)	
93	-	Kendall William, pork butcher (p.1156)	Goebbels Cornelius, pork butcher (p.928)
94	-	Myers Elias, government store dealer (p.1263)	Mannock Charles, furniture dealer (p.1075)
95	-	Steer Geo. oilman (p.1432)	Gardner Fredc. Charles leather seller (p.917)
96	-	Rand George, hairdresser (p.1336)	Forte Joseph, hairdresser (p.904)
97	-	Cooksey Daniel, furnishing undertaker (p.920)	Cooksey Daniel & Son, furnishing undertakers
98	-	Abrallams Alfred, furniture dealer (p.766)	Abrahams & Sons, furniture dealers (p.706)
99	-	Wilson Joseph, tea dealer (p.1532)	Kerslake Samuel George, grocer (p.1022)

A5. Islington conservation areas

TABLE A5.1 Conservation areas	**Façades**	**Doors**	**Tot Façade Length (m)**	**Mean Façade Length (m)**	**Door encounter rate (m)**
Angel	253	355	2356	9.3	6.6
Arlington Sq.	509	704	3010	5.9	4.3
Barnsbury	1834	2314	12292	6.7	5.3
Canonbury	324	429	2702	8.3	6.3
Chapel Market	172	259	1287	7.5	5.0
Duncan-Colebrooke	907	1287	6312	7.0	4.9
Upper St North	326	538	2932	9.0	5.4
Conservation areas	4325	5886	30891	7.7	5.2
Non-protected areas	974	1473	12433	12.8	8.4

Table A5.1. Islington, London – conservation areas; street interface. (c.2013)

TABLE A5.2 Conservation areas; Threshold use	Façades	Doors	Domestic	Commercial	Community	Other
Angel	253	355	83 23.4%	237 66.8%	3 0.8%	32 9.0%
Arlington Sq.	509	704	673 95.6%	25 3.5%	3 0.4%	3 0.4%
Barnsbury	1834	2314	2139 92.4%	143 6.2%	27 1.2%	5 0.2%
Canonbury	324	429	387 90.2%	18 4.2%	17 4.0%	7 1.6%
Chapel Market	172	259	86 33.2%	158 61.0%	10 3.9%	5 1.9%
Duncan-Colebrooke	907	1287	1160 90.1%	65 5.0%	36 2.8%	26 2.0%
Upper St North	326	538	263 48.9%	212 39.4%	42 7.8%	21 3.9%
Conservation areas	4325	5886	4191 71.2%	858 14.6%	138 2.5%	99 1.7%
Non-conservation areas	974	1473	977 66.3%	293 19.9%	104 7.1%	99 6.7%

Table A5.2. Islington, London – conservation areas; building threshold use. (c.2013)

TABLE A5.3 Conservation areas; Threshold type	Façades	Doors	Direct	Indirect	Blank
Angel	253	355	335 94.4%	20 5.6%	26 7.3%
Arlington Sq.	509	704	475 67.5%	229 32.5%	28 4.0%
Barnsbury	1834	2314	1484 64.1%	830 35.9%	154 6.6%
Canonbury	324	429	246 57.3%	183 42.7%	29 6.7%
Chapel Market	172	259	240 92.7%	19 7.3%	7 2.7%
Duncan-Colebrooke	907	1287	791 61.5%	496 38.5%	29 2.2%
Upper St North	326	538	458 85.1%	80 14.9%	24 4.5%
Conservation areas	4325	5886	4029 68.4%	1857 31.6%	297 5.0%
Non-conservation areas	974	1473	917 62.3%	556 37.7%	151 10.2%

Table A5.3. Islington, London – conservation areas; building threshold type. (c.2013)

TABLE A5.4 Conservation areas; Mixing of uses	**Segments**	**Group 1**	**Group 2**	**Group 3**	**Group 4**	**Group 0**
Angel	40	6 15.0%	21 52.5%	8 20.0%	1 2.5%	4 10.0%
Arlington Sq.	37	22 59.5%	11 29.7%	1 2.7%	2 5.4%	1 2.7%
Barnsbury	132	83 62.9%	35 26.5%	12 9.1%	0 0.0%	2 1.5%
Canonbury	48	29 60.4%	10 20.8%	4 8.3%	0 0.0%	5 10.4%
Chapel Market	17	3 17.6%	9 52.9%	4 23.5%	0 0.0%	1 5.9%
Duncan-Colebrooke	78	35 44.9%	30 38.4%	12 15.4%	0 0.0%	1 1.3%
Upper St North	46	11 23.9%	19 41.3%	12 26.1%	4 8.7%	0 0.0%

Table A5.4. Islington, London – conservation areas; street segments' mixing of uses. (c.2013)

TABLE A5.5 Conservation areas; Building types	**Façades**	**Doors**	**Terrace**	**Corner Terrace**	**Villa**	**Council Housing**
Angel	253	355	179 70.7%	15 5.9%	0 0.0%	0 0.0%
Arlington Sq.	509	704	463 91.0%	7 1.4%	0 0.0%	5 1.0%
Barnsbury	1834	2314	1460 79.6%	24 1.3%	26 1.4%	86 4.7%
Canonbury	324	429	225 69.4%	3 0.9%	18 5.5%	42 13.0%
Chapel Market	172	259	125 72.7%	9 5.2%	0 0.0%	4 2.3%
Duncan-Colebrooke	907	1287	794 87.5%	14 1.5%	0 0.0%	15 1.6%
Upper St North	326	538	222 68.1%	9 2.8%	0 0.0%	18 5.5%
Conservation areas	4325	5886	3468 80.2%	81 1.9%	44 1.0%	170 5.0%
Non-conservation areas	974	1473	279 28.6%	14 1.4%	1 0.1%	205 21.0%

Table A5.5. Islington, London – conservation areas; street segments' mixing of uses. (c.2013)

A6. High resolution maps

A6.1. Islington, London

Figure A6.1. Islington, London – building thresholds and land use. (c.2013)

Background map: © 2013 Crown Copyright. An Ordnance Survey/EDINA supplied service.

A6. High resolution maps

A6.2. The West Village, Manhattan

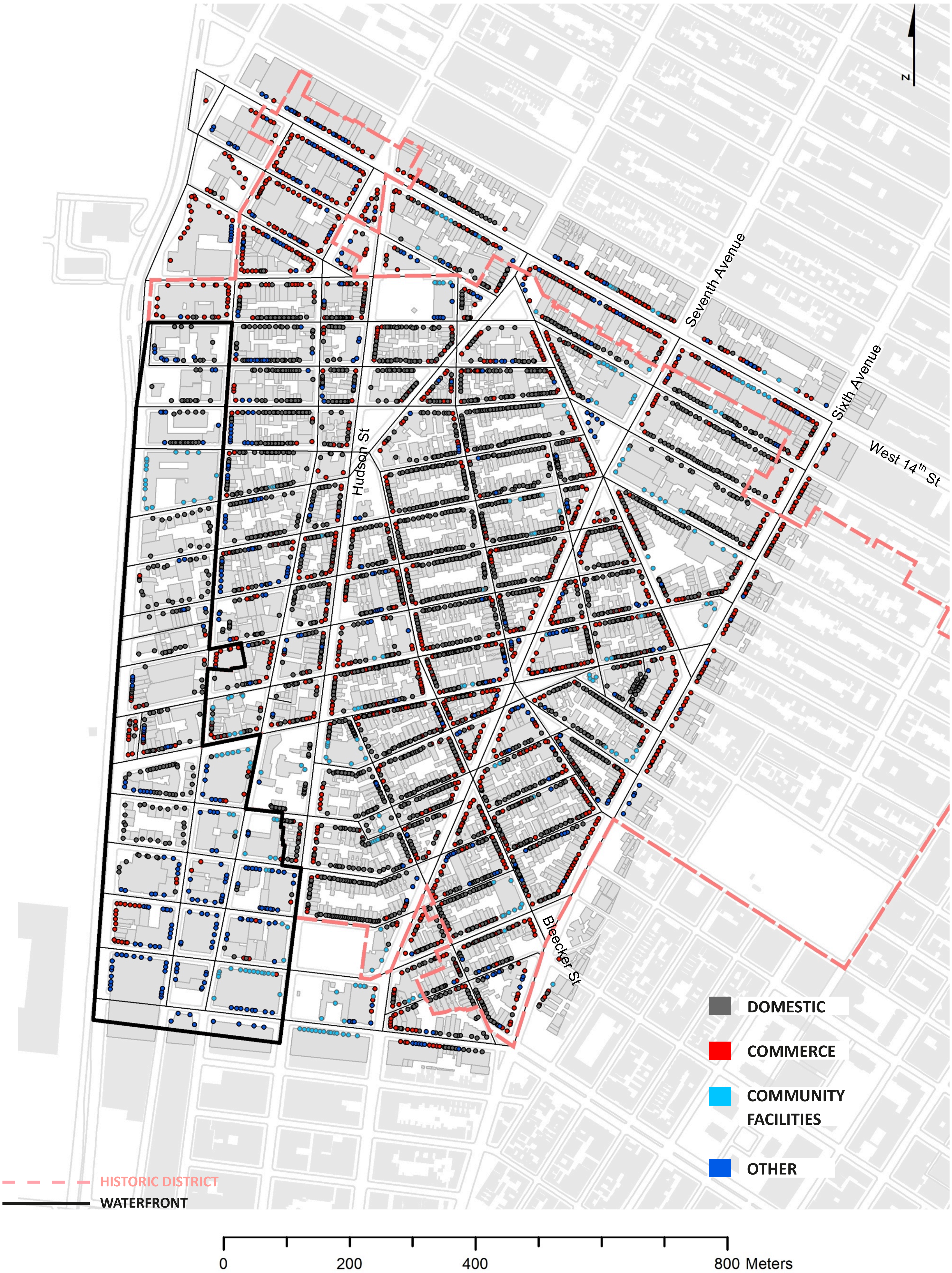

Figure A6.2. The West Village, Manhattan – building thresholds and land use. (c.2011)

Background map: © 2011 Department of Information Technology and Telecommunications, NYC.

A7. Interface density measures – street segment sides; sample record of data and measures from the two case studies

CASE_STUDY	SIDE	depthmap_r	slength_m	blfront_length	facades	doors	primary	bf/sl	bf/sl_id	tf	htf/tf	tfp	htfp/tfp	htf/tf_id	htfp_id
ISL	1.00	2936.00	79.27	44.72	6.00	12.00	6.00	0.56	2.00	3.73	1.56	7.45	0.78	3.00	1.00
ISL	1.00	3848.00	31.50	26.87	1.00	2.00	0.00	0.85	3.00	13.43	0.43	0.00	0.00	1.00	0.00
ISL	1.00	3853.00	81.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISL	1.00	3854.00	79.05	72.79	8.00	15.00	14.00	0.92	3.00	4.85	1.20	5.20	1.12	2.00	2.00
ISL	1.00	4207.00	96.00	85.05	10.00	19.00	17.00	0.89	3.00	4.48	1.30	5.00	1.16	3.00	2.00
ISL	1.00	4209.00	34.97	32.89	2.00	3.00	2.00	0.94	3.00	10.96	0.53	16.45	0.35	1.00	1.00
ISL	1.00	4210.00	31.19	36.36	3.00	3.00	1.00	1.17	3.00	12.12	0.48	36.36	0.16	1.00	1.00
ISL	1.00	4211.00	15.08	10.35	2.00	2.00	2.00	0.69	3.00	5.18	1.12	5.18	1.12	2.00	2.00
ISL	1.00	4212.00	33.90	27.43	2.00	3.00	3.00	0.81	3.00	9.14	0.63	9.14	0.63	1.00	1.00
ISL	1.00	4213.00	92.40	81.88	9.00	15.00	10.00	0.89	3.00	5.46	1.06	8.19	0.71	2.00	1.00
ISL	1.00	4214.00	29.29	23.04	5.00	2.00	2.00	0.79	3.00	11.52	0.50	11.52	0.50	1.00	1.00
ISL	1.00	4215.00	35.50	27.59	5.00	8.00	8.00	0.78	3.00	3.45	1.68	3.45	1.68	3.00	3.00
ISL	1.00	4216.00	25.24	9.05	2.00	2.00	2.00	0.36	2.00	4.52	1.28	4.52	1.28	3.00	3.00
ISL	1.00	4217.00	25.04	33.60	4.00	4.00	4.00	1.34	3.00	8.40	0.69	8.40	0.69	1.00	1.00
ISL	1.00	4218.00	30.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISL	1.00	4219.00	31.95	23.75	1.00	3.00	3.00	0.74	3.00	7.92	0.73	7.92	0.73	1.00	1.00
ISL	1.00	4220.00	26.79	18.87	3.00	2.00	2.00	0.70	3.00	9.44	0.61	9.44	0.61	1.00	1.00
ISL	1.00	4221.00	85.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISL	1.00	4222.00	54.02	51.48	1.00	6.00	2.00	0.95	3.00	8.58	0.68	25.74	0.23	1.00	1.00
ISL	1.00	4223.00	50.06	48.22	9.00	11.00	11.00	0.96	3.00	4.38	1.32	4.38	1.32	3.00	3.00
ISL	1.00	4224.00	34.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISL	1.00	4225.00	71.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISL	1.00	4226.00	87.49	74.33	4.00	9.00	7.00	0.85	3.00	8.26	0.70	10.62	0.55	1.00	1.00
ISL	1.00	4228.00	34.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISL	1.00	4229.00	81.82	84.09	2.00	2.00	0.00	1.03	3.00	42.04	0.14	0.00	0.07	1.00	1.00
ISL	1.00	4230.00	74.74	57.58	5.00	9.00	6.00	0.77	3.00	6.40	0.91	9.60	0.60	2.00	1.00
ISL	1.00	4231.00	45.11	46.01	3.00	3.00	2.00	1.02	3.00	15.34	0.38	23.01	0.25	1.00	1.00
ISL	1.00	4232.00	32.54	22.98	1.00	2.00	0.00	0.71	3.00	11.49	0.50	0.00	0.50	1.00	1.00
ISL	1.00	4233.00	76.10	67.20	12.00	16.00	13.00	0.88	3.00	4.20	1.38	5.17	1.12	3.00	2.00
ISL	1.00	4234.00	30.52	27.02	5.00	7.00	5.00	0.89	3.00	3.86	1.50	5.40	1.07	3.00	2.00
ISL	1.00	4235.00	44.78	47.54	9.00	11.00	9.00	1.06	3.00	4.32	1.34	5.28	1.10	3.00	2.00
ISL	1.00	4236.00	71.48	68.16	13.00	15.00	13.00	0.95	3.00	4.54	1.28	5.24	1.11	3.00	2.00
ISL	1.00	4237.00	63.56	52.20	8.00	14.00	13.00	0.82	3.00	3.73	1.56	4.02	1.44	3.00	3.00
ISL	1.00	4238.00	55.32	19.07	3.00	2.00	1.00	0.35	2.00	9.53	0.61	19.07	0.30	1.00	1.00
ISL	1.00	4239.00	79.11	47.56	3.00	8.00	6.00	0.60	2.00	5.95	0.98	7.93	0.73	2.00	1.00
ISL	1.00	4240.00	26.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISL	1.00	4241.00	37.86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISL	1.00	4242.00	21.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISL	1.00	4243.00	32.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISL	1.00	4244.00	32.32	29.58	6.00	5.00	0.00	0.92	3.00	5.92	0.98	0.00	0.00	2.00	0.00
ISL	1.00	4245.00	30.44	26.38	5.00	3.00	0.00	0.87	3.00	8.79	0.66	0.00	0.00	1.00	0.00
ISL	1.00	4246.00	23.06	24.01	5.00	4.00	0.00	1.04	3.00	6.00	0.97	0.00	0.00	2.00	0.00
ISL	1.00	4247.00	33.63	23.81	5.00	4.00	3.00	0.71	3.00	5.95	0.97	7.94	0.73	2.00	1.00
ISL	1.00	4248.00	68.89	59.13	12.00	12.00	12.00	0.86	3.00	4.93	1.18	4.93	1.18	2.00	2.00
ISL	1.00	4249.00	97.42	73.08	14.00	12.00	11.00	0.75	3.00	6.09	0.95	6.64	0.87	2.00	2.00
ISL	1.00	4250.00	62.86	48.23	9.00	0.00	0.00	0.77	3.00	0.00	0.00	0.00	0.00	0.00	0.00
ISL	1.00	4251.00	53.86	33.41	5.00	1.00	1.00	0.62	2.00	33.41	0.17	33.41	0.17	1.00	1.00
ISL	1.00	4253.00	148.72	86.86	9.00	11.00	7.00	0.58	2.00	7.90	0.73	12.41	0.47	1.00	1.00
ISL	1.00	4254.00	138.34	113.45	14.00	26.00	19.00	0.82	3.00	4.36	1.33	5.97	0.97	3.00	2.00
ISL	1.00	4255.00	106.84	83.07	14.00	20.00	13.00	0.78	3.00	4.15	1.40	6.39	0.91	3.00	2.00
ISL	1.00	4256.00	103.85	15.46	1.00	0.00	0.00	0.15	1.00	0.00	0.00	0.00	0.00	0.00	0.00

CASE_STUDY	SIDE	depthmap_r	slength_m	blfront_length	facades	doors	primary	bf/sl	bf/sl_id	tf	htf/tf	tfp	htfp/tfp	htf/tf_id	htfp_id
WV	1.00	7177.00	78.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WV	1.00	7178.00	110.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WV	1.00	7179.00	66.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WV	1.00	7180.00	201.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WV	1.00	6630.00	74.76	60.24	4.00	6.00	4.00	0.81	3.00	10.04	0.64	15.06	0.42	1.00	1.00
WV	1.00	4277.00	81.03	39.46	2.00	5.00	0.00	0.49	2.00	7.89	0.81	7.89	0.81	2.00	2.00
WV	1.00	4278.00	84.65	61.13	1.00	5.00	2.00	0.72	3.00	12.23	0.52	30.56	0.21	1.00	1.00
WV	1.00	4279.00	79.93	61.30	3.00	7.00	4.00	0.77	3.00	8.76	0.73	15.33	0.42	1.00	1.00
WV	1.00	4280.00	81.79	60.74	2.00	2.00	2.00	0.74	3.00	30.37	0.21	30.37	0.21	1.00	1.00
WV	1.00	4281.00	120.62	86.29	1.00	5.00	5.00	0.72	3.00	17.26	0.37	17.26	0.37	1.00	1.00
WV	1.00	4282.00	58.68	43.20	4.00	4.00	4.00	0.74	3.00	10.80	0.59	10.80	0.59	1.00	1.00
WV	1.00	4283.00	18.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WV	1.00	4284.00	82.98	63.97	4.00	8.00	8.00	0.77	3.00	8.00	0.80	8.00	0.80	2.00	2.00
WV	1.00	4285.00	82.14	61.89	2.00	1.00	1.00	0.75	3.00	61.89	0.10	61.89	0.10	1.00	1.00
WV	1.00	4286.00	82.50	50.83	3.00	7.00	3.00	0.62	2.00	7.26	0.88	16.94	0.38	2.00	1.00
WV	1.00	4287.00	80.71	60.25	5.00	4.00	4.00	0.75	3.00	15.06	0.42	15.06	0.42	1.00	1.00
WV	1.00	4288.00	52.69	45.11	1.00	1.00	1.00	0.86	3.00	45.11	0.14	45.11	0.14	1.00	1.00
WV	1.00	4272.00	71.62	49.07	3.00	4.00	3.00	0.69	3.00	12.27	0.52	16.36	0.39	1.00	1.00
WV	1.00	4273.00	63.46	47.96	2.00	1.00	1.00	0.76	3.00	47.96	0.13	47.96	0.13	1.00	1.00
WV	1.00	4274.00	70.58	52.93	4.00	5.00	4.00	0.75	3.00	10.59	0.60	13.23	0.48	1.00	1.00
WV	1.00	4275.00	70.69	51.95	3.00	3.00	3.00	0.74	3.00	17.32	0.37	17.32	0.37	1.00	1.00
WV	1.00	4276.00	27.71	15.29	3.00	3.00	3.00	0.55	2.00	5.10	1.26	5.10	1.26	3.00	3.00
WV	1.00	6802.00	143.03	111.77	1.00	6.00	3.00	0.78	3.00	18.63	0.34	37.26	0.17	1.00	1.00
WV	1.00	6803.00	137.93	117.17	9.00	26.00	12.00	0.85	3.00	4.51	1.42	9.76	0.66	3.00	1.00
WV	1.00	6804.00	48.51	44.19	3.00	7.00	7.00	0.91	3.00	6.31	1.01	6.31	1.01	2.00	2.00
WV	1.00	6805.00	32.61	21.36	1.00	2.00	2.00	0.66	2.00	10.68	0.60	10.68	0.60	1.00	1.00
WV	1.00	6806.00	134.76	29.48	1.00	5.00	2.00	0.22	1.00	5.90	1.09	14.74	0.43	2.00	1.00
WV	1.00	4415.00	108.23	75.51	1.00	6.00	1.00	0.70	3.00	12.58	0.51	75.51	0.08	1.00	1.00
WV	1.00	4416.00	150.79	125.11	10.00	22.00	13.00	0.83	3.00	5.69	1.13	9.62	0.67	2.00	1.00
WV	1.00	4417.00	54.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WV	1.00	4324.00	72.82	57.87	1.00	1.00	0.00	0.80	3.00	57.87	0.11	0.00	0.00	1.00	0.00
WV	1.00	4325.00	79.75	40.49	2.00	5.00	3.00	0.51	2.00	8.10	0.79	13.50	0.47	1.00	1.00
WV	1.00	4326.00	45.30	19.44	1.00	3.00	2.00	0.43	2.00	6.48	0.99	9.72	0.66	2.00	1.00
WV	1.00	4327.00	34.26	19.44	1.00	2.00	2.00	0.57	2.00	9.72	0.66	9.72	0.66	1.00	1.00
WV	1.00	4328.00	79.31	51.42	4.00	4.00	3.00	0.65	2.00	12.86	0.50	17.14	0.37	1.00	1.00
WV	1.00	4329.00	77.72	38.22	3.00	3.00	1.00	0.49	2.00	12.74	0.50	38.22	0.17	1.00	1.00
WV	1.00	4330.00	81.27	71.81	1.00	1.00	1.00	0.88	3.00	71.81	0.09	71.81	0.09	1.00	1.00
WV	1.00	4331.00	68.93	27.87	1.00	1.00	0.00	0.40	2.00	27.87	0.23	0.00	0.00	1.00	0.00
WV	1.00	4332.00	64.67	48.78	1.00	0.00	0.00	0.75	3.00	0.00	0.00	0.00	0.00	0.00	0.00
WV	1.00	4333.00	69.10	53.48	1.00	1.00	0.00	0.77	3.00	53.48	0.12	0.00	0.00	1.00	0.00
WV	1.00	4334.00	69.50	51.31	1.00	7.00	7.00	0.74	3.00	7.33	0.87	7.33	0.87	2.00	2.00
WV	1.00	4335.00	104.22	75.92	2.00	7.00	1.00	0.73	3.00	10.85	0.59	75.92	0.08	1.00	1.00
WV	1.00	4322.00	78.41	15.04	1.00	1.00	1.00	0.19	1.00	15.04	0.43	15.04	0.43	1.00	1.00
WV	1.00	4323.00	88.19	62.92	2.00	4.00	1.00	0.71	3.00	15.73	0.41	62.92	0.10	1.00	1.00
WV	1.00	4179.00	81.01	62.94	5.00	8.00	6.00	0.78	3.00	7.87	0.81	10.49	0.61	2.00	1.00
WV	1.00	4180.00	86.46	62.54	2.00	7.00	6.00	0.72	3.00	8.93	0.72	10.42	0.61	1.00	1.00
WV	1.00	4426.00	112.91	69.04	5.00	7.00	7.00	0.61	2.00	9.86	0.65	9.86	0.65	1.00	1.00
WV	1.00	4427.00	146.48	129.24	8.00	22.00	20.00	0.88	3.00	5.87	1.09	6.46	0.99	2.00	2.00
WV	1.00	4429.00	257.76	214.80	18.00	34.00	19.00	0.83	3.00	6.32	1.01	11.31	0.57	2.00	1.00
WV	1.00	4430.00	276.65	243.35	21.00	54.00	45.00	0.88	3.00	4.51	1.42	5.41	1.18	3.00	2.00
WV	1.00	4431.00	276.74	243.22	15.00	44.00	41.00	0.88	3.00	5.53	1.16	5.93	1.08	2.00	2.00